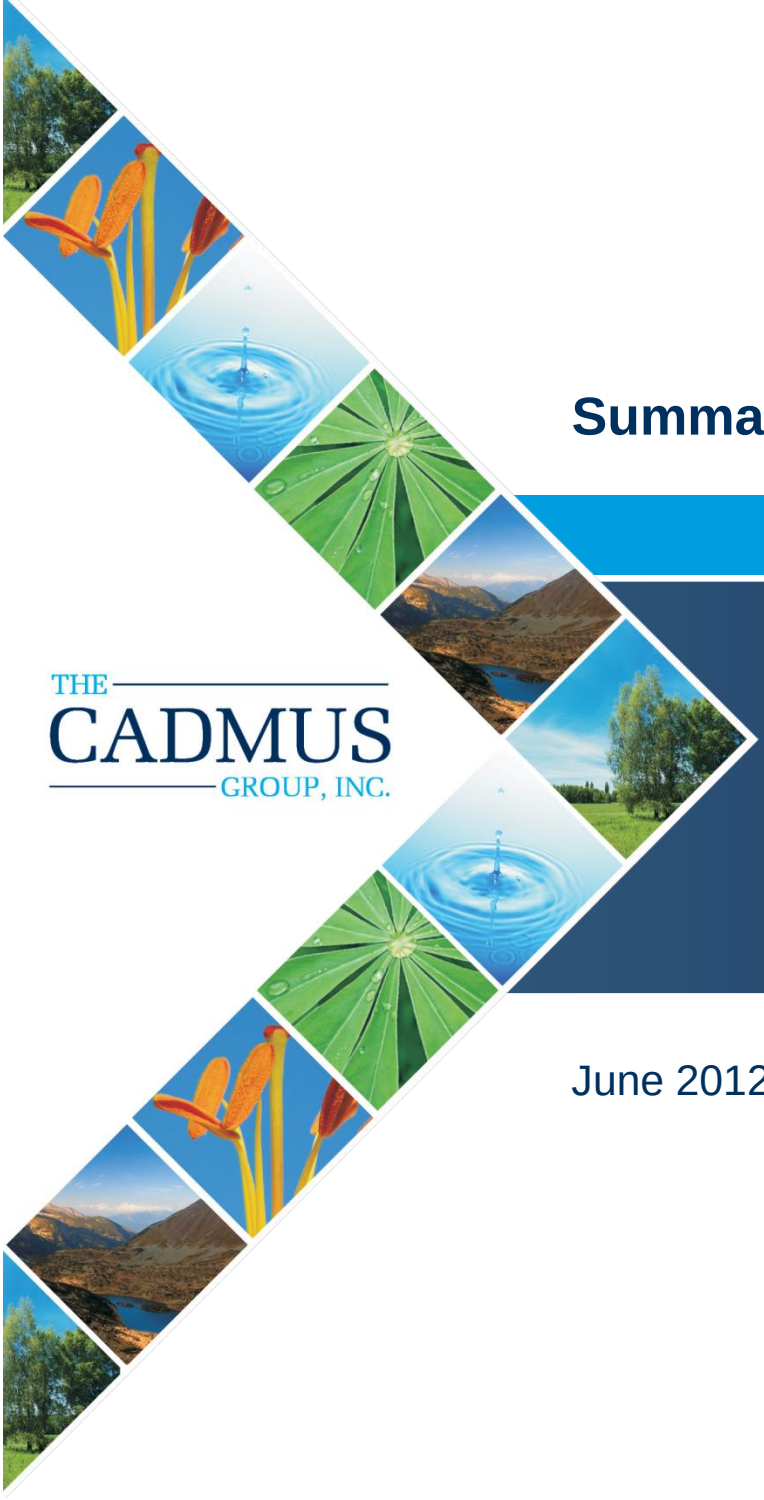

Summary Report

Ameren Illinois Company
Plan 1
Gas Portfolio

June 2012

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1. RESULTS SUMMARY

Ameren Illinois Company (AIC) began implementing its gas program portfolio in June 2008, and ended its first planning period (Plan 1) on May 31, 2011.[1] The portfolio consisted of the following programs:

- ***Residential Multifamily Program (Multifamily Program):*** The Multifamily Program offered multiple services to privately owned multifamily buildings with three or more units. Participating buildings received energy audits, direct installation of compact fluorescent light bulbs (CFLs), and water conservation measures.
- ***Home Energy Performance Program (HEP Program):*** The HEP Program, which by PY3 included a lower-income pilot called Warm Neighbors Cool Friends (WNCF), offered home diagnostics and improvement services to AIC's residential customers for a $25 fee. Auditors installed faucet aerators, low-flow showerheads, water heater pipe insulation, and CFLs. Auditors then assessed the home for potential shell measures (air sealing and insulation) and HVAC upgrades, using proprietary software. Participants received a customized report of identified shell and HVAC measure recommendations and a list of certified contractors (HEP insulation installers and HVAC Program allies).
- ***Heating and Cooling Program (HVAC Program):*** The HVAC Program, which also included HVAC incentives paid through WNCF, offered incentives to heating and cooling contractors to encourage the purchase of energy-efficient central air conditioners (CAC), air source heat pumps (ASHPs), ground source heat pumps (GSHPs), gas furnaces, and gas boilers. Initiated in PY2, and through February 12, 2011, this program and the WNCF pilot also included incentives for right-sizing cooling units according to Air Conditioning Contractors of America Manual J. The Manual J sizing incentives were discontinued after February 12, 2011 because of the low realization rate estimated during the Program Year 2 (PY2) evaluation.
- ***Small Business Green Nozzles:*** The Green Nozzles Program was part of AIC's Small Business Gas Food Service Program. By installing free low-flow pre-rinse spray nozzles in place of less flow-efficient nozzles, the Green Nozzle Program aimed to reduce therms associated with water heating in eligible AIC restaurants, commercial kitchens, bar and grills, and other locations that perform food service/food preparation activities. The lower flow rate nozzles use less hot water, and therefore less gas.
- ***Small Business HVAC:*** The Small Business HVAC program offered AIC's small commercial and industrial customers prescriptive incentives to tune-up HVAC equipment, including air conditioners, gas boilers and gas furnaces. In addition, the program provided incentives to replace gas boilers and gas furnaces with energy efficient models. The program required AIC pre-approval before work commenced, as well as documentation of project completion through the final application process.
- ***Direct Install of Faucet Aerators:*** In PY3, AIC implemented a pilot initiative to install faucet aerators and low flow showerheads in facilities that previously received a green

[1] Electric results as well as process results are summarized in the Ameren Illinois Company Plan 1 Residential Portfolio Summary report, dated April 2012, prepared by The Cadmus Group.

nozzle as part of the Green Nozzles Program, as well as hotels, motels or restaurant facilities that belong to the GDS2 rate class. AIC customers contacted the program in response to targeted mailings and trained plumbers were responsible for the installation of the measures, and received a combined incentive of $100 per customer site visit and $10 per aerator installed.

- ***Demand Response:*** AIC offers a Demand Control Thermostat program for both residential and small businesses. Through these programs, eligible residential and small business customers received a Comverge SuperStat Programmable Thermostat that cycles the customer's AC unit upon receipt of an Ameren Illinois signal during peak demand periods. These programs were not evaluated by Cadmus or ODC and therefore savings reported herein were provided by AIC.

AIC hired Conservation Services Group (CSG) as the lead implementer for all residential portfolio programs and SAIC as the lead C&I implementer. AIC hired the Cadmus team, consisting of The Cadmus Group, Inc., Opinion Dynamics, Inc. and Tetra Tech, to conduct impact and process evaluations of the residential portfolio. The Cadmus team developed portfolio evaluation plans for each of the three years in Plan 1.

Table 1 shows the participation and gross realized savings for each program and year of Plan 1, while Table 2 shows the realized net savings. Figures 1 and 2 show the percent of gross and net therm savings provided by each program in each year.

Table 1. Participation and Gross Realized Savings by Program and Year

Program	Participation				Gross Realized Savings (Therms)			
	PY1	PY2	PY3	Cumulative Total	PY1	PY2	PY3	Cumulative Total
Multifamily	69* 5,358**	134* 4,998**	166* 5,357**	369* 15,713***	40,541	28,039	56,602	125,182
HVAC	N/A	6,127**	8,995**	15,122**	N/A	1,038,401	1,528,070	2,566,470
HEP	1,455**	4,883**	3,486**	9,824**	4,816	64,470	208,125	277,412
SB HVAC	N/A	50**	135**	185**	N/A	20,347	77,991	98,338
SB Green Nozzles***	N/A	1,301**	148**	1,449**	N/A	1,481,428	168,205	1,649,633
DI Faucet Aerators	N/A	N/A	504**	504**	N/A	N/A	8,547	8,547
SB Demand Respond	N/A	638	8	646	N/A	29040	244	29,284
Residential Demand Response	N/A	1,599	899	2,498	N/A	62,361	35,061	97,422
Total	**6,823**	**19,596**	**19,532**	**45,951**	**45,357**	**2,724,086**	**2,082,845**	**4,852,288**

* Number of facilities. ** Number of measures ***Savings include installation adjustment

Table 2. NTG and Net Realized Savings by Program and Year

Program	NTG			Net Realized Savings (Therms)			
	PY1	PY2	PY3	PY1	PY2	PY3	Cumulative Total
Multifamily	0.8	1	0.96	31,340	28,039	54,505	113,884
HVAC	NA	0.49	1.02	N/A	511,041	1,558,428	2,069,469
HEP	0.8	0.92	0.99	3,853	59,633	205,854	269,340
SB HVAC	N/A	1	0.8	N/A	20,347	62,393	82,740
SB Green Nozzles	N/A	0.82	0.82	N/A	1,213,424	137,928	1,351,352
DI Faucet Aerators	N/A	N/A	0.8	N/A	N/A	6,837	6,837
SB Demand Respond	N/A	0.80	0.80	N/A	23,232	195	23,427
Residential Demand Response	N/A	0.77	0.77	N/A	47,970	26,970	74,940
Total	**0.78**	**0.70**	**0.99**	**35,193**	**1,903,686**	**2,053,110**	**3,991,989**

Figure 1. Percentage of Gross Savings by Program and Year

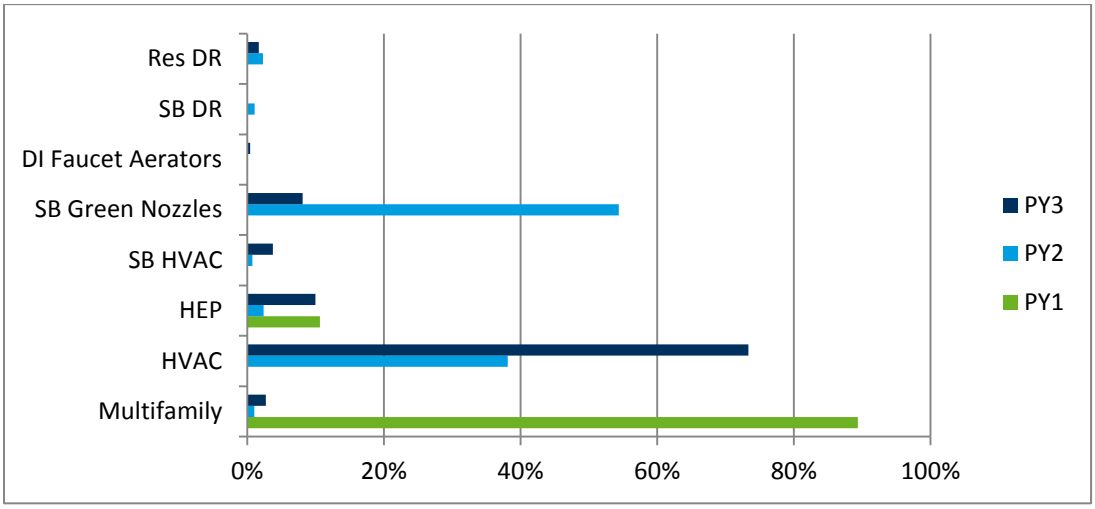
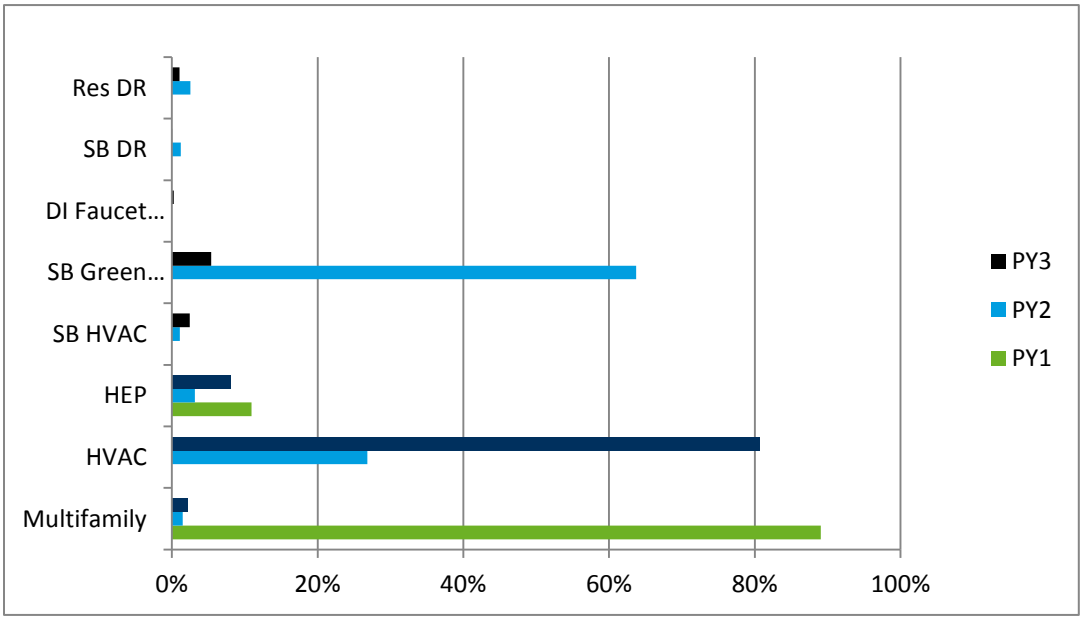


Figure 2. Percentage of Net Savings By Program by Year



The remainder of this report describes the evaluation activities we performed over the three-year plan period, specific changes to inputs that occurred over time, and then a three-year summary for each program. The appendices include annual results for each of the three programs.

2. EVALUATION ACTIVITIES

The Cadmus team performed a variety of impact evaluation activities for each program containing gas measures in each Plan 1 year. Table 3 lists each program and its corresponding impact evaluation activities. Each impact-related task shown in the table is defined below.

- ***Document Review:*** For this task, we reviewed a sample of program documents such as rebate forms and invoices, and compared them to the program database to verify information in the program database.
- ***Participant Surveys:*** In PY2, Cadmus conducted participant surveys in all five programs to estimate freeridership. In PY3, Cadmus performed a participant survey in the HVAC program to estimate freeridership and spillover.
- ***Market Actor Interviews:*** In PY3, Cadmus interviewed HVAC contractors, both participants and drop-outs, to inform the NTG ratio.
- ***Database Analysis:*** We analyzed the program databases for all programs in each year to summarize participation and calculate program savings.
- ***Secondary Research:*** In the case of the HVAC and HEP programs, when the PY2 participant surveys were confounded by the additional tax and federal stimulus incentives, Cadmus relied on secondary research or the results of similar programs implemented elsewhere to estimate NTG ratios.
- ***Site Visits:*** All three programs included site visits in PY2 to verify installations. We also performed field measurements and metering for the HVAC program to measure gross savings from the installation of high-efficiency HVAC equipment.
- ***Impact Analysis:*** We used engineering estimates to estimate savings for the multifamily and HEP programs in all program years. For the impact analysis, we used engineering modeling and metering to estimate unit savings to apply to the HVAC program database participant data. For the SB HVAC and Green Nozzles program we conducted an engineering review in PY2 to assess the algorithms used to calculate gas savings attributable to the measures incented through the programs.
- ***NTG Analysis:*** In PY1, Cadmus used default estimates for NTG analysis. In PY2, Cadmus interviewed multifamily building managers to obtain self-report estimates of freeridership. Cadmus also performed participant surveys for HVAC and HEP programs in PY2; however, we found that participants were unable to distinguish the effect of AIC's incentives from the tax and federal stimulus incentives also available that year. Therefore, we applied secondary research from other similar programs to estimate freeridership. We estimated spillover for HEP in PY2 and applied the same number to PY3 from those who received the audit and then installed insulation on their own without a rebate. In PY3 we performed a participant survey, participating contractor survey, and non-participating (or drop-out) contractor surveys to estimate HVAC program NTG. We calculated freeridership from the participant survey. We estimated HVAC spillover in PY3 from participant surveys who reported installing additional energy efficiency

measures after their participation and from non-participant contractors who reported continuing to promote high efficiency units even after dropping out of the program.

Table 3. Program Impact Evaluation Activities By Year

Action	Program Year		
	PY1	PY2	PY3
Multifamily			
Documents Review		✓	
Participant Surveys		✓	
Database Analysis	✓	✓	✓
Site Visits		✓	
Impact Analysis	✓	✓	
Primary NTG Research		✓	
HVAC			
Documents Review	N/A	✓	✓
Participant Surveys	N/A	✓	✓
Market Actor Interviews	N/A	✓	✓
Database Analysis	N/A	✓	✓
Secondary Research	N/A	✓	
Site Visits	N/A	✓	
Impact Analysis Field Measurements Metering Analysis Engineering Modeling/Calculations	N/A	 ✓ ✓ ✓	 ✓
Primary NTG Research		✓	✓
Home Energy Performance			
Documents Review		✓	
Participant Surveys		✓	
Database Analysis	✓	✓	✓
Secondary Research		✓	✓
Site Visits		✓	
Impact Analysis Engineering Modeling/Calculations	 ✓	 ✓	
Primary NTG Research		✓	
Small Business HVAC			
Participant Surveys	N/A	✓	
Database Analysis	N/A	✓	✓
Primary NTG Research*	N/A	✓	
SB Green Nozzles			
Participant Surveys	N/A	✓	
Database Analysis	N/A	✓	✓
Primary NTG Research	N/A	✓	
DI Faucet Aerator			
Database Analysis	N/A	N/A	✓

Note: While the team gathered NTG related information from participants, the small sample size and participant responses led us not to apply this NTGR in PY2 or PY3.

3. INPUT ASSUMPTIONS CHANGES

Over Plan 1's three years, input assumptions used to calculate unit savings impacts changed only for domestic hot water measures, which were part of both the HEP and Multifamily programs. During PY1, the Cadmus team compared default savings estimates to estimates calculated through CSG's audit savings. During PY2 and PY3, the Cadmus team performed engineering calculations to estimate results directly. Table 4 and Table 5 show how the input assumptions for aerators and low-flow showerheads changed between PY2 and PY3. The Cadmus team recommends AIC use the PY3 estimates described in Appendix A of the PY3 Final HEP Report going forward.

Table 4. Revised Input Parameters for Estimate of Default Saving, Aerators

Assumption	PY2		PY3	
	Kitchen Aerator	Bathroom Aerator	Kitchen Aerator	Bathroom Aerator
Efficient Aerator Flow Rate	1.84	1.48	2.2	1.5
Baseline Aerator Flow Rate	2.13*	1.87*	2.75	2.25
Water Heater Recovery Efficiency	100%	100%	100%	100%
Temperature In (degrees Fahrenheit)	53.9	53.9	53.9	53.9
Temperature Out (degrees Fahrenheit)	80	80	80	80
Length of Use (in minutes per day per person)	5	5	5	5
Days per Year at Home	352.25	352.25	352.25	352.25
Annual Aerator Savings per Person	***1.5 therms***	**1.8 *therms***	***2.7 therms***	**3.7 *therms***
Annual Aerator Savings per Person, Weighted	**1.79 therms**	***1.79 therms***	**3.7 therms**	***3.7 therms***
People per Single Family Home	2.67	2.67	2.67	2.67
Sinks per Single Family Home	3.83	3.83	3.83	3.83
Annual Savings per Aerator in Single Family Home	***1.2 therms***	***1.2 therms***	***2.6 therms***	***2.6 therms***
People per Multifamily Home	2.14	2.14	2.14	2.14
Sinks per Multifamily Home	2.46	2.46	2.46	2.46
Annual Savings per Aerator in Multifamily Home	***1.6 therms***	***1.6 therms***	***3.2 therms***	***3.2 therms***

*PY2 numbers assumed flow rates are throttled, while PY3 numbers do not.

Table 5. Revised Input Parameters for Estimate of Default Savings, Low-Flow Showerheads

Assumption	PY2	PY3
Efficient Showerhead Throttled Flow Rate	1.82	2
Baseline Showerhead Throttled Flow Rate	2.26	2.67
Water Heater Recovery Efficiency	100%	100%
Temperature In (degrees Fahrenheit)	53.9	53.9
Temperature Out (degrees Fahrenheit)	105	105
Length of Shower (in minutes per day per person)	8.2	8.2
Days per Year at Home	352.25	352.25
Annual Savings per Person	**7.1 therms**	**10.7 therms**
People per Single Family Home	2.67	2.67
Showers per Single Family Home	1.79	1.79
Annual Savings per Showerhead in Single Family Home	***10.6 therms***	***16 therms***
People per Multifamily Home	2.14	2.14
Showers per Multifamily Home	1.3	1.3
Annual Savings per Showerhead in Multifamily Home	***11.7 therms***	***17.7 therms***

Within the business portfolio, the Cadmus team also conducted an engineering review in PY2 to assess the algorithms used to calculate gas savings attributable to the measures incented through the SB HVAC and Green Nozzles programs. The team did not recommend any changes to the SB HVAC algorithms, but did suggest a revision to the Green Nozzle algorithm.

Table 6. Revised Input Parameters for Estimate of Default Savings, Green Nozzles

Assumption	Original Deemed Savings Calculation (Ex ante)	Ex Post Savings Calculation
Flow rate 1 (gal/min)	1.6	2.3
Flow rate 2 (gal/min)	0.7	0.65
Hours per day	3	4.3
Days (days/year)	365	362
Heater efficiency	70%	67.6%
Temp rise in water heater	70°	73°
Output – Gross Savings	***492.6 Therms***	***1386.2 Therms***
NTGR	0.8	0.82
Output - Net Savings	***394 Therms***	***1122.8 Therms***

4. MULTIFAMILY THREE YEAR SUMMARY

Table 7 presents a summary of program participation. The number of aerators and showerheads installed increased from the beginning of the program through PY3. PY3 was the first year in which gas savings from common area measures occurred.

Table 7. Summary of Program Participation

Measure	PY1 Installations	PY2 Installations	PY3 Installations	Total Installations
In-Unit				
Faucet Aerators Installed	2,535	2,555	3,246	8,336
Pipe Insulation	886	474	91	1,451
Showerheads	1,937	1,969	2,007	5,913
Common-Area				
Air Sealing	0	0	11	11
Pipe Insulation	0	0	1	1
Showerheads	0	0	1	1
Total	5,358	4,998	5,357	15,713

Impact Findings

Table 8 shows that both gross and net savings have increased over the years. PY3 savings are significantly higher than PY1 or PY2, while PY2 actually dropped slightly from PY1. NTG ratios have gone from 80% in PY1 to 100% in PY2 and 96% in PY3. The NTG ratio dropped in PY3 due to the addition of common-area measures.

Table 8. Summary of Total Savings: *Ex Ante* Gross, Realized Gross, and Net

Measure	PY1	PY2	PY3	Total
Total Gross Savings (Therms)	40,541	28,039	56,602	125,182
Net to Gross	0.8	1.0	0.96	0.91
Total Net Savings (Therms)	31,340	28,039	54,505	113,884

As summarized in Table 9, unit savings estimates for in-unit DWH measures evolved over time. Realized per-unit savings estimates used in the PY1 evaluation were based on an initial engineering review of the data. In PY2, Cadmus extended the scope of the review and looked at both the Multifamily Program assumptions and the HEP Program assumptions together. In PY3, Cadmus further examined the engineering analysis for faucet aerators and low-flow showerheads and available secondary information and recalculated the savings yielding higher results than originally calculated in PY2. Per-unit lighting savings estimates remained constant over time.

Table 9. Summary of Gross Unit Savings for Different In-Unit Measures

Measure	PY1 Gross Realized per-unit (Therms)	PY2 Gross Realized per-unit (Therms)	PY3 Gross Realized per-unit (Therms)
Faucet Aerators Installed	1.2	1.6	3.2
Low-Flow Shower Heads Installed	1.9	11.7	17.7
Hot Water Pipe Insulation Installed	18.6	2.3	2.3

5. HEP PROGRAM THREE YEAR SUMMARY

A summary of program participation is presented in Table 10. The number of HEP shell measure incentives requested steadily increased from the beginning of the program through PY3. This occurred although overall program participation fell in PY3—the number of audits from 2,987 in PY2 to 1,888 in PY3—which reduced the number of measures directly installed.

Table 10. Summary of Program Participation

Measure	PY1 Installations	PY2 Installations	PY3 Installations	Total Installations
Audits	769	2,987	1,888	5,644
Faucet Aerators Installed	750	1,406	661	2,817
Low-Flow Shower Heads Installed	661	2,456	1,705	4,822
Hot Water Pipe Insulation Installed	43	762	87	892
Infiltration = 0.35 ACH	-	61	311	372
Ceiling Insulation (R-7 to R-38)	-	-	10	10
Ceiling Insulation (R-11 to R-38)	-	48	240	288
R-11 Wall Insulation	-	25	179	204
Programmable Thermostat	1	125	293	419

Impact Findings

Table 11 shows how all savings types—*ex ante*, gross, and net— have all increased over the years. PY3 savings are more than triple the savings in PY2. In addition, realization rates have changed over the years, with a PY1 realization rate of 11% followed by 81% and 78%, respectively, in PY2 and PY3. Net to Gross (NTG) ratios have gone from 80% in PY1 to 99% in PY3. Overall, the realization rate over three years is 71% and the NTG ratio is 97%. In total, net savings were 269,340 therms.

Table 11. Summary of Total Savings – *Ex Ante* Gross, Realized Gross, and Net

Program Year	Total Ex Ante Gross Savings (Therms)	Total Realized Gross Savings (Therms)	Realization Rate	Net to Gross	Total Net Savings (Therms)
PY1	43,610	4,816	11%	80%	3,853
PY2	79,318	64,470	81%	92%	59,633
PY3	265,494	208,125	78%	99%	205,854
Program Total	388,422	277,412	71%	97%	269,340

As summarized in Table 12, one of the reasons realization rates have varied through the years are the evolving per unit energy savings per measure that Cadmus has established. Realized per-unit savings estimates used in the PY1 evaluation were based on CSG tracking data collected during HEP audits. In PY2, savings estimates were expanded to include shell measures (air sealing, wall, and ceiling insulation), and programmable thermostat. Shell measure and programmable thermostat estimates were based on Energy-10 modeling and HEP audit data that estimated the typical Ameren Illinois HEP participant single family home. In addition, an engineering analysis was performed to update the DHW measure unit savings in PY2. In PY3, the engineering

analysis for faucet aerators and low-flow showerheads was further examined and found to yield higher savings than originally calculated in PY2.

Table 12. Summary of Gross Realized Unit Savings for Different Measures

Measure	PY1 Gross Realized per-unit (Therms)	PY2 Gross Realized per-unit (Therms)	PY3 Gross Realized per-unit (Therms)
Faucet Aerators Installed	2.49	1.2	2.6
Low-Flow Shower Heads Installed	4.35	10.6	16.0
Hot Water Pipe Insulation Installed	1.28	2.3	2.3
Infiltration = 0.35 ACH	-	196	196
Ceiling Insulation (R-7 to R-38)	-	114	114
Ceiling Insulation (R-11 to R-38)	-	75	75
R-11 Wall Insulation	-	442	442
Programmable Thermostat	20	67	67

Tables 13, 14, and 15 show the nine installed HEP gas measures and the number of installations, *ex ante* gross savings, realized gross savings, the realization rate, and net savings for PY1, PY2 and PY3, respectively. Similar to the unit savings used in these impact analyses, the NTG ratio also changed through the years. In PY1, the AIU default assumption of 80% was deemed reasonable given that no participant survey had been conducted. In PY2, we performed a participant survey to establish freeridership and spillover. In addition, we established shell measure NTG by averaging the NTG results of other similar home energy performance evaluation studies. In PY3, we further refined shell measure NTG by bringing new studies to the estimate and re-examining these studies to address spillover.

Table 13. PY1 Net *Ex Ante* and Realized Savings

Measure	Number Installed	Gross Ex Ante Savings (Therms)	Gross Realization Rate)	Gross Realized Savings (Therms	NTG	Net Realized Savings (Therms)
Faucet Aerators	750	15,000	12%	1,868	80%	1,494
Low-Flow Shower Heads	661	26,440	11%	2,875	80%	2,299
Hot Water Pipe Insulation	43	2,150	3%	55	80%	44
DHW Subtotal	1454	43,590	11%	4,798	80%	3,837
Programmable Thermostat	1	20	100%	20	80%	16
Gas Program Total	***1,455***	***43,610***	***11%***	***4,818***	***80%***	***3,853***

Table 14. PY2 *Ex Ante* Gross Savings, Realized Savings, and Net Savings

Measure	Number Installed	Gross Ex Ante Total (Therm)	Gross Realization Rate	Gross Realized Savings (Therm)	NTG	Realized Total (THM)
Faucet Aerators Installed	1,406	8,436	20%	1,687	104%	1,749.07
Low Flow Shower Heads Installed	2,456	22,104	118%	26,034	101%	26,281
Hot Water Pipe Insulation Installed	762	6,858	26%	1,753	98%	1,712
DHW Subtotal	*4,624*	*37,398*	*32%*	*11,981*		*29,742*
Infiltration = 0.35 ACH	61	17,080	*70%*	*11,981*	104%	12,485
Ceiling Insulation (R-7 to R-38)	-	-		-	67%	
Ceiling Insulation (R-11 to R-38)	48	3,840	94%	3,596	67%	2,409
R-11 Wall Insulation	25	18,500	60%	11,047	67%	7,400
Shell Measure Subtotal	*134*	*39,420*	*68%*	*26,623*		*22,294*
Programmable Thermostat	125	*2,500*	*335%*	*8,374*	91%	7,597
Gas Program Total		**79,318**	**81%**	**64,470**		**59,633**

Table 15. PY3 *Ex Ante* Gross Savings, Realized Savings, and Net Savings

Measure	Number Installed	Gross Ex Ante Total (THM)	Gross Realization Rate	Gross Realized Total (THM)	NTG*	Realized Total (THM)
Faucet Aerators	661	3,966	43%	1,719	104%	1,782
Low-Flow Shower Heads	1705	15,345	178%	27,280	101%	27,539
Hot Water Pipe Insulation	87	783	26%	200	98%	195
DHW Subtotal	*2453*	*20,094*	*145%*	*29,199*		*29,516*
Air Sealing	311	87,080	70%	61,082	104%	63,348
Ceiling Insulation (R-7 to R-38)	10	800	143%	1,142	97%	1,106
Ceiling Insulation (R-11 to R-38)	240	19,200	94%	17,978	97%	17,423
R-11 Wall Insulation	179	132,460	60%	79,097	97%	76,653
Shell Measure Subtotal	*740*	*239,540*	*67%*	*159,299*		*158,531*
Programmable Thermostats	*293*	*5,860*	*335%*	*19,628*	*91%*	*17,807*
Gas Program Subtotal	***3,486***	***265,494***	***78%***	***208,125***	**99%**	**205,854**

* Includes spillover where applicable.

6. HVAC THREE YEAR SUMMARY

A summary of program participation is presented in Table 16 below. Participation levels increased from PY2 to PY3, and benefited from additional incentives for energy-efficient boilers and incentives targeted to underserved markets via the WNCF pilot program.

Table 16. Program Participation

Measure	PY2 Installations	PY3 Installations			Program Total
		Heating and Cooling	WNCF	Total	
New Gas Furnace (92% AFUE)	427	312	0	312	739
New Gas Furnace (95% AFUE)	5,700	8,516	23	8,539	14,239
New Gas Boiler (90% AFUE)	0	142	2	144	144
Total	***6,127***	***8,970***	***25***	***8,995***	***15,122***

Evaluation Findings

Gross Impact

A summary of the gross impact evaluation findings is presented in Table 17 below. We estimated the per-unit savings using the Energy-10 energy simulation model to predict energy consumption of a home using data input from actual PY3 and PY2 program installations and home size information from the PY2 survey of program participants. In the PY3 evaluation, we expanded Energy-10 models to include energy-efficient gas boilers. We based savings estimates on an average AFUE and an average unit capacity installed during the respective program year.

Table 17. Program Gross Energy Savings

Measure	Ex Ante Per Unit (Therms)	Realized Per Unit (Therms)	Realization Rate	PY2 Energy Savings (Therm)	PY3 Energy Savings (Therm)	Program Total
New Gas Furnace (92% AFUE)	161	146	91%	62,330	45,543	107,873
New Gas Furnace (95% AFUE)	194	171	88%	976,071	1,462,223	2,438,294
New Gas Boiler (90% AFUE)	230	166	72%	N/A	20,304	20,304
Gas Program Total				**1,038,401**	**1,528,070**	**2,566,470**

Gross *ex ante* savings estimates submitted in the PY3 database were not revised to reflect PY2 evaluation outcomes, resulting in the same realization rates for the installation of new gas furnaces in the PY3 evaluations. The overall realization rate for the program was 88%.

Net Impact

For the PY3 evaluation, Cadmus used three surveys of participating contractors, non-participating contractors, and participating customers to establish freeridership and spillover. We calculated the net-to-gross (NTG) ratio according the following formula:

$$NTG = 1 - Freeridership + Spillover$$

Using the survey results, Cadmus analyzed freeridership using five different methods, considering the views of contractors and participants. After reviewing and comparing the results of each method, we chose the results from the participant customer survey as being the most valid to estimate freeridership, which had a value of 47% and 46% for furnaces and boilers, respectively.

Two sources of spillover were also estimated for the PY3 evaluation:

1. ***Additional energy-efficiency purchases by customers who received a program incentive.*** These additional energy-efficiency purchases had to be: (a) strongly influenced by the customer's participation in this program, and (b) not incentivized through another Ameren Illinois program. This spillover was estimated through the participating customer survey. This spillover amount from the gas HVAC measures installed, included a variety of measures savings for both gas and electricity. Therefore spillover was calculated in BTUs and estimated at 14.5% and 14% of program savings for furnaces and boilers, respectively.

2. ***From customers who purchased energy-efficiency HVAC equipment through a nonparticipating contractor.*** This might have occurred because a number of nonparticipating contractors originally signed up for the program then dropped out, but are still promoting the higher efficiency units to their customers. We interviewed these "drop out" contractors to assess how many additional high-efficiency units were sold due to Ameren Illinois' program. The result was an additional 34% and 32% of program savings for furnaces and boilers, respectively.[2] Contractors installing gas furnaces reported that the percentage of high efficiency units was significantly higher than it would have been had they not participated in the program.

Combining freeridership and spillover resulted in a total NTG of 102% and 101% for furnaces and boilers, respectively. Cadmus compared the PY3 NTG results to those found in other similar programs.

[2] While the spillover percentage of program savings estimated for gas measures of approximately 34% is much higher than the similarly computed electric program spillover from non-participant contractors (6%), the reason is due to the smaller total savings of the gas program relative to the electric program. Non-participant spillover is computed by applying the difference in predicted percentage of high efficiency units sold to the average product sales and the drop-out contractor's population, multiplied by estimated savings per unit. This additional spillover amount is then divided by total program savings to estimate spillover percentage. The spillover amount on the gas side is a greater portion of program savings relative to electric. Responses by non-participant contractors were similar between gas and electric measures. We also note that due to the small sample size and large variation of responses, the precision around this spillover estimate is +- 89%.

In the original PY2 evaluation, Cadmus conducted secondary research to determine an average NTG ratio of 49%. All of these reports included only freeridership in the calculations. Additional incentives available during PY2, including the federal tax credit, impeded Cadmus from calculating NTG based on responses to the PY2 participant survey. Participants were unable to separate the impact of the Ameren program incentive from the influence of the tax credit. Without reliable participant survey results, Cadmus conducted secondary research and examined other recent HVAC program evaluations and their estimates of freeridership. As shown in Table 18, Cadmus found an average net-to-gross (NTG) ratio of 49% (51% freeridership) from other studies of gas savings in HVAC programs.

Table 18. Net-to-Gross Estimated from Other HVAC Program Evaluations

Net to Gross	Source
34%	HEHE Process and Impact Evaluation Final, October 27, 2010, Table 4-3.
51%	Unpublished evaluation study of a Midwestern utility, 2010.
55%	New Jersey's Clean Energy Program Residential HVAC Impact Evaluation and Protocol Review, June 2009, Table 6-16.
60%	Overview of DEER NTFR Update Process for 2006-2007 Programs, Table 3-2.
39%	Residential Retrofit High Impact Measure Evaluation Report, Prepared for the California Public Utilities Commission Energy Division February 8, 2010, p. 15. (*average of dealer and residential survey)*
69%	Questar Gas ThermWise® Evaluation, September 28, 2010, Table 37.
37%	Piedmont Natural Gas Energy-Efficiency Programs Evaluation: Year One (March–October 2009), Prepared for Piedmont Natural Gas Company, April 22, 2010.
49%	**Average**

Tables 19 and 20 summarize the program's *ex ante* gross savings, realized gross savings, the realization rate, and net savings for PY2 and PY3, respectively.

Table 19. PY2 *Ex Ante* Gross Savings, Realized Savings, and Net Savings

Measure	Ex Ante Gross Savings (Therm)	Realized Gross Savings (Therm)	Realization Rate	NTG	Net Energy Savings (Therm)
New Gas Furnace (92% AFUE)	68,747	62,330	91%	49.2%	30,675
New Gas Furnace (95% AFUE)	1,105,800	976,071	88%	49.2%	480,366
Total	***1,174,547***	***1,038,401***			***511,041***

Table 20. PY3 *Ex Ante* Gross Savings, Realized Savings, and Net Savings

Measure	Ex Ante Gross Savings (Therm)	Realized Gross Savings (Therm)	Realization Rate	NTG	Net Energy Savings (Therm)
New Gas Furnace (92% AFUE)	50,232	45,543	91%	102%	46,454
New Gas Furnace (95% AFUE)	1,656,566	1,462,223	88%	102%	1,491,467
New Gas Boiler (90% AFUE)	33,120	20,304	72%	101%	20,507
Total	***1,739,918***	***1,528,070***			***1,558,428***

7. SMALL BUSINESS GREEN NOZZLES PROGRAM THREE YEAR SUMMARY

Table 21 presents a summary of program installations in PY2 and PY3. The Green Nozzles Program instituted a significant ramp down in PY3 with only 148 nozzles installed compared to 1,301 in PY2.

Table 21. Summary of Program Participation

	PY1 Installations	PY2 Installations	PY3 Installations	Total Installations
Green Nozzle Program	N/A	1,301	148	1,449

Impact Findings

A summary of the gross impact evaluation findings is presented in Table 22 below. In PY3, Ameren Illinois modified the program's green nozzle algorithm, specifically flow rate and days of use assumptions based on the results of the PY2 evaluation. In addition, while the measure provided through the program remained the same, the program included an in-service factor to account for the 18% removal rate among participating customers (also recommended in PY2).

Table 22. Summary of Green Nozzle Total Savings - *Ex Ante* Gross, Realized Gross, and Net

Program Year	Total Ex Ante Gross Savings (Therms)	Total Realized Gross Savings (Therms)	Net to Gross	Total Net Savings (Therms)
PY1	N/A	N/A	N/A	N/A
PY2	640,873	1,481,428	0.82	1,213,242
PY3	168,205	168,205	0.82	137,928
Program Total	***809,078***	***1,649,633***		***1,351,170***

Net Impact

The goal of the PY2 net impact analysis was to determine the program's net effect on participating customer's gas usage. Net program impacts were derived by estimating a net-to-gross-ratio (NTGR) based on self-reported information from the CATI survey. The NTGR quantified the percentage of the gross program impacts that can reliably be attributed to the program. NTGRs were calculated based on both the level of free-ridership and participant spillover. Spillover occurs when a participant takes additional energy efficient actions outside of any energy efficiency program that are influenced by their participation in the program.

Free-ridership

Free-riders are program participants who would have implemented the incented energy efficient measure(s) even without the program. These estimates are based on a series of questions that explore the influence of the program in making the energy efficient installations as well as likely

actions had the incentive not been available. For the majority of projects included in the survey, we developed a net-to-gross factor that consists of two scores: overall influence and influence of program timing.

1. **Overall influence.** This score was based on two survey questions. The first question asked respondents about their previous purchases of low-flow pre-rinse nozzles. The second question asked whether, if they had not received the nozzle for free from Ameren Illinois, they would have purchased it on their own. If they had previously purchased a similar nozzle and would have purchased one without the program, program influence is low which means a higher level of free-ridership.

2. **Influence of program timing.** This score was developed based on two questions: 1) the likelihood that the exact same equipment would have been installed without the program (on a scale of 0 to 10) and 2) if the installation would have been done at the same time without the program. This score takes the response to the likelihood question and adjusts this value by the responses to the timing questions. A greater likelihood of participating without the program means a higher level of free-ridership. Later implementation without the program means a lower level of free-ridership.

Each score could take on a value of 0 to 10, where a higher score means a lower level of free-ridership. The overall free ridership factor for a project was the average of the two scores, divided by 10. The NTGR equals one minus the free ridership value. Therefore, the net-to-gross ratio for each project ranged from 0 (100% free-ridership) to 1 (no free-ridership).

A NTGR, weighted by the ex post therms of the surveyed projects, was applied to the population gross impact to obtain a net impact of the program before any spillover was applied.

Spillover

Participant spillover refers to energy efficiency installations that were influenced by the program but did not receive an incentive. An example of participant spillover is a customer who received free equipment, such as a pre-rinse nozzle, at one facility and, as a result of the positive experience, installs additional equipment at other facilities because of the program but does not request an incentive or perform additional efficiency related actions in the same facility.

Spillover was examined using participant responses to the telephone survey through a set of questions asking first whether the customer installed energy efficiency equipment (such as lighting or additional nozzles) at their site for which they did not receive an incentive. If this occurred, we asked about the influence of the program in the installation of this additional equipment. If the customer indicated a high level of influence (i.e., a rating of 8-10 on a 0-10 scale), we considered this evidence of spillover.

We found 222 therms associated with participant action outside of the program that was attributed it to the Act On Energy Business Program. The team estimated savings associated with the installation of an energy efficient water heater, an action taken by one program participant. After applying this spillover, we adjusted the NTGR from 0.81 to 0.82.

8. SMALL BUSINESS HVAC PROGRAM THREE YEAR SUMMARY

Table 23 presents a summary of program participation. While participation has remained limited, the program saw an increase in the number of measures installed between PY2 and PY3.

Table 23. Summary of Program Participation

	PY1 Installations	PY2 Installations	PY3 Installations	Total Installations
SB HVAC Program	N/A	53	135	188

Impact Findings

The PY3 ex post gross impact estimates are based on the engineering review performed in PY2 in which the evaluation team did not recommend any changes to the algorithms currently used to calculate gas savings from the program. Additionally, we applied the Net to Gross Ratio (NTGR) used for program planning as research was not conducted in PY3 on participant decision-making.

Table 24. Summary of Total Savings: *Ex Ante* Gross, Realized Gross, and Net

Program Year	Total Ex Ante Gross Savings (Therms)	Total Realized Gross Savings (Therms)	Net to Gross	Total Net Savings (Therms)
PY1	N/A	N/A	N/A	N/A
PY2	20,347	20,347	1.0	20,347
PY3	77,991	77,991	0.8	62,393
Program Total	***98,338***	***98,338***		***82,740***

Table 25 summarizes the savings by measure type. Across both program years gas furnace replacement has accounted for the largest share of therm savings.

Table 25. Summary of Ex Ante Gross Savings by Measure

Measure	PY1 Gross Realized Savings by Measure (Therms)	PY2 Gross Realized Savings by Measure (Therms)	PY3 Gross Realized Savings by Measure (Therms)
Gas Boiler Tune-up	N/A	4,315	6,795
Gas Furnace Tune-up	N/A	5,427	6,764
Gas Boiler Replacement	N/A	1,180	18,809
Gas Furnace Replacement (Energy Star (90%+ AFUE)	N/A	-	389
Gas Furnace Replacement (92%+ AFUE)	N/A	2,700	8,356
Gas Furnace Replacement (94%+ AFUE)	N/A	6,725	36,877
Total	***-***	***20,347***	***77,991***

9. DIRECT INSTALL OF FAUCET AERATOR PILOT THREE YEAR SUMMARY

Table 26 presents a summary of program installations in PY3. The pilot sent targeted mailings to recruit customers in two waves. The first wave of outreach featured 1,360 mailers aimed at customers located near Peoria, Quincy, Galesburg, Champaign/Urbana, and Metro East while the second went to 720 customers in Decatur, Springfield, Marion/Carbondale, Mattoon, and Effingham.

Table 26. Summary of Program Participation

	PY1 Installations	PY2 Installations	PY3 Installations	Total Installations
DI Faucet Aerators	N/A	N/A	504	504

Impact Findings

The evaluation team did not conduct a full impact analysis of the Direct Installation of Faucet Aerators Pilot given its small contribution to the overall C&I portfolio. As a result, ex ante impacts were equal to ex post as is illustrated in the following table containing the energy impacts for the pilot.

Table 27. Summary of Direct Install Faucet Aerator Total Savings - *Ex Ante* Gross, Realized Gross, and Net

Program Year	Total Ex Ante Gross Savings (Therms)	Total Realized Gross Savings (Therms)	Net to Gross	Total Net Savings (Therms)
PY1	N/A	N/A	N/A	N/A
PY2	N/A	N/A	N/A	N/A
PY3	8,547	8,547	0.8	6,837
Program Total	***8,547***	***8,547***		***6,837***

APPENDIX A. MULTIFAMILY ANNUAL RESULTS

PY3 Results

Date: **April 17, 2012**

To: **Karen Kansfield, Ameren Illinois**

From: **Jane Colby and Ross Notebaart, The Cadmus Group, Inc.**

Re: **Multifamily Gas Impact Evaluation**

Introduction

Ameren Illinois' Multifamily Program offers free water conservation measures that also save gas (efficient showerheads, faucet aerators, and pipe insulation), as well as lighting efficiency improvements and electric water heating measures that save electricity for residential customers. This memo summarizes the gas savings impacts from this program.

Impact Calculations

Cadmus used the domestic hot water (DHW) unit savings we developed through an engineering analysis in November 2011[3] for the impact calculations. These savings are shown in Table 1.

Table 1. DHW Unit Gas Savings

	Faucet Aerator		Low-Flow Showerheads		Pipe Insulation	
	Savings	Per	Savings	Per	Savings	Per
Gas (in therms)	3.2	aerator	17.7	showerhead	2.3	insulation job

Impact Findings

Cadmus evaluated the savings for both in-unit and common-area gas measures installed in PY3. A total of 55 unique properties with gas water heating participated during PY3, in which 52 sites installed in-unit measures and 12 sites installed common-area measures. As the in-unit measures were provided at no cost to building owners, the freeridership rate is zero[4] and gross savings are the same as net savings. For common-area measures, the freeridership rate was 0.8[5] and resulted in a different gross and net savings. We summarized savings by measure and program type as

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[3] PY3 Multifamily Program Evaluation, Appendix A, dated November 2011, prepared for Ameren Illinois by The Cadmus Group.

[4] Because measures are directly installed and free, they do not fit the definition of free riders ("a participant who would have purchased the same measure at the same time without the program.")

[4] For common-area measures, Cadmus applied the NTG ratio of 0.8 estimated through the surveys of building owners and managers from PY2, as used in the PY3 Multifamily Program Evaluation report, November 2011.

shown in Table 2 and Table 3. The program saved a total of 56,602 gross therms and 54,506 net therms during PY3, the majority from low-flow showerheads (two gallons per minute), which also reduced water consumption.

Table 2. Multifamily Program Gross and Net Gas Savings, In-Unit

Measure	Quantity Installed	Deemed unit savings (therms)	Total Gross and Net Savings
Faucet Aerator	3,246	3.2	10,387
Pipe Insulation	91	2.3	209
Showerhead (2.0 gpm)	2,007	17.7	35,524
Total			**46,120**

Table 3. Multifamily Program Gross and Net Gas Savings, Common-Area

Measure	Quantity Installed	Total Gross Savings	Total Net Savings
Air Sealing	11	9,871	7,896
Pipe Insulation	1	256	205
Showerhead (2.0 gpm)	1	355	284
Total		**10,482**	**8,385**

PY2 Results

Date: **March 8, 2011**

To: **Karen Kansfield, Ameren Illinois**

From: **Jane Colby and Cynthia Kan, The Cadmus Group, Inc.**

Re: **Multifamily Gas Impact Evaluation Final**

Introduction

Ameren Illinois' Multifamily Program offers free water conservation measures that also save gas (efficient showerheads, faucet aerators, and pipe insulation), as well as lighting efficiency improvements and electric water heating measures that save electricity for residential customers. In a previous report,[6] Cadmus reported on the results of the task completed in PY2, shown in Table 1. This previous report included an impact evaluation of the electric savings only. **The purpose of this memo is to provide the impact evaluation of the gas savings portion of the Multifamily Program.**

Table 1. Summary of PY2 Multifamily Evaluation Tasks

Action	Impact	Process	Details
Database Review and Impact Calculations	✓		Calculated gross and net savings by multiplying default estimates by the number of installed measures.
Document Review	✓	✓	Reviewed program documentation including records of marketing outreach, customer applications, and all verification documentation on a sample of buildings enrolled in the program.
Participant Survey	✓	✓	Verified installation of materials and assessed program marketing and outreach, along with the application process, delivery, and incentives.
Evaluability Assessment		✓	Reviewed program materials for consistency, practicality, and clarity to allow for easier and more cost-effective future evaluations.
Stakeholder Interviews		✓	Interviewed program management and implementation staff to provide insight into program design, marketing, and delivery.
Site Visits	✓	✓	Verified measure installation.

[6] Multifamily Properties Program Evaluation—PY2.

Impact Calculations

Cadmus used the domestic hot water (DHW) unit savings we developed through an engineering analysis in January 2010[7] for the impact calculations. These savings are shown in Table 2.

Table 2. DHW Unit Gas Savings

	Faucet Aerator		Low-Flow Showerheads		Pipe Insulation	
	Savings	Per	Savings	Per	Savings	Per
Gas (in therms)	1.6	aerator	11.7	showerhead	2.3	insulation job

Impact Findings

A total of 67 unique properties with gas water heating participated during PY2. As the in-unit measures were provided at no cost to building owners, the freeridership rate is zero[8] and gross savings are the same as net savings. We summarized savings by measure as shown in Table 3. The program saved 28,039 therms during PY2, the majority from low-flow showerheads (two gallons per minute), which also reduced water consumption.

Table 3. Multifamily Program Gross and Net Gas Savings

Measure	Quantity Installed	Deemed unit savings (therms)	Total Gross and Net Savings
Faucet Aerator	2,555	1.6	3,984
Pipe Insulation	474	2.3	1,080
Showerhead (2.0 gpm)	1,969	11.7	22,975
Total			**28,039**

[7] Memo from Cadmus to Karen Kansfield, February 7, 2011: Domestic Hot Water Savings Analysis Addendum to PY2 Multifamily and Home Energy Performance Reports.

[8] Since measures are directly installed and free, they don't fit the definition of free riders "a participant who would have purchased the same measure at the same time without the program".

PY1 Results

Date: **November 20, 2009**

To: **Karen Kansfield**

From: **Ulrike Mengelberg**

Re: **Review of Multifamily Gas Program PY1**

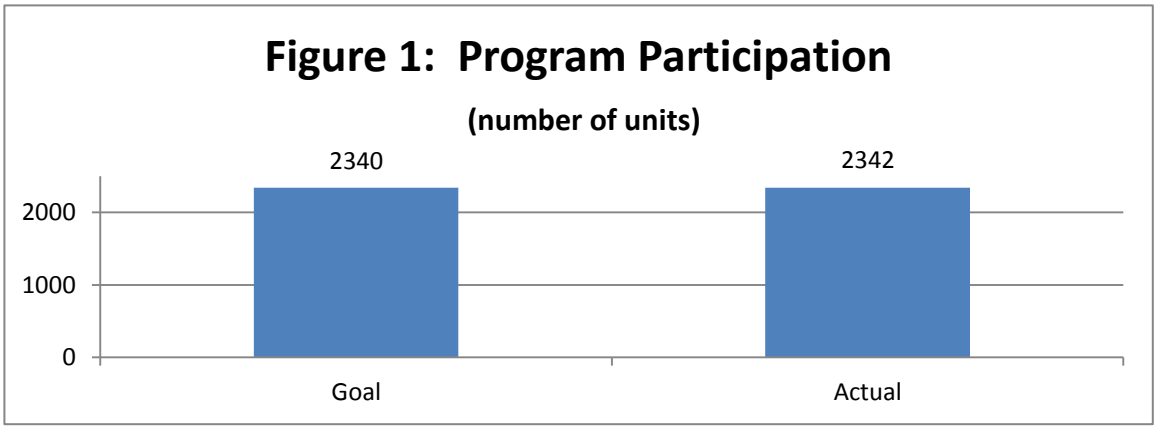
AIU's Multifamily Program (the Program) offers multifamily building owners/managers and private contractors incentives to promote installation of energy-efficient measures. The gas saving measures include: faucet aerators, pipe insulation, and 2.0 gpm showerheads. The electric side of the program includes: lighting in common areas; providing energy audits for installation of central AC unit diagnostics; and tune-up measures in tenant spaces.

The program offers building owners and managers compact fluorescent lamps (CFLs) and water conservation measures for installation in residential units, and leaves residents with information on measures installed and other energy-saving tips. The program also offers custom measures (windows, replacements of rooftop AC units), which will be subject to an energy audit to validate cost-effectiveness and establish incentive levels. These more complex measures have yet to be implemented.

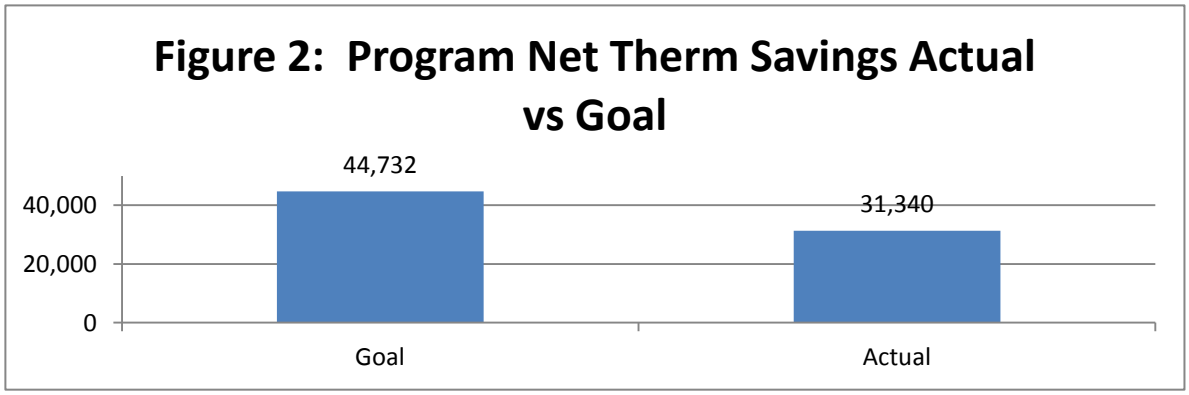
The program started strongly, with a solid and well-operated design. We found AIU and CSG program staff communicated clearly and consistently. Given these strengths, we offer only limited recommendations for changes in PY2.

For a full review of the Multifamily Electric Program, including the results of process interviews with program implementers (AIU and CSG personnel) to determine what did and did not work for the Multifamily Program's Year 1 (PY1), please see the report *Multifamily Buildings Program Evaluation*. The Multifamily Gas Program results, which were very similar to those of the Multifamily Electric program, are summarized below:

- **Goals Attained**. The program slightly exceeded its participation goals, as shown in Figure 1, below. Numbers of gas measures installed and resulting savings are provided in Appendix A.

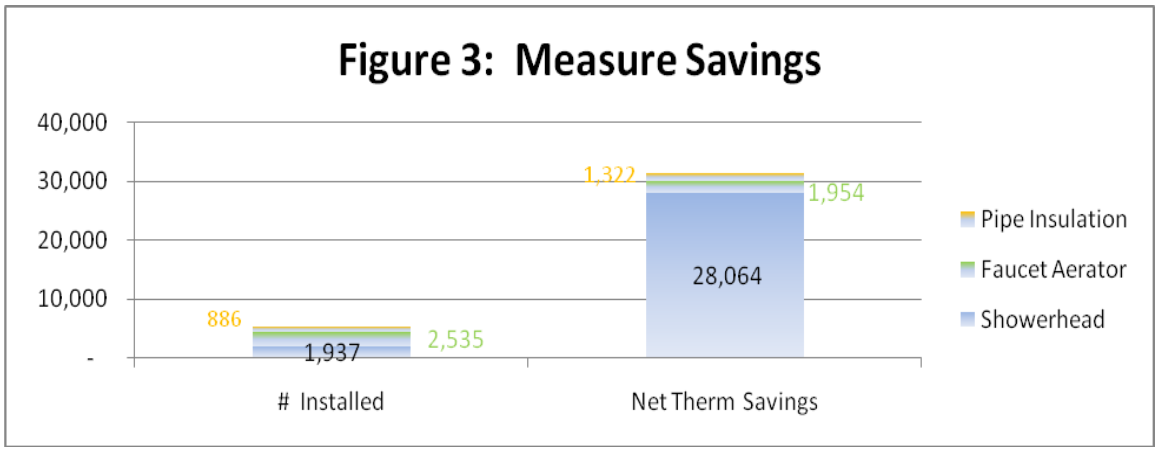


- **Gas Goals not Attained**. While participation and MWh goals were exceeded, Ameren achieved only 70% of its Therm savings goal. This partly can be attributed to changes in savings attributed to pipe insulation. For this analysis, measure savings estimates for pipe insulation were decreased from 30 to 11.4 Therms per pipe wrap measure installed. Cadmus has conducted research on deemed savings for pipe insulation in different areas of the nation, and has found savings estimates of 11.4 Therms[9] per year more accurate than the deemed savings estimates used by the Program. Program net savings results, as compared to the Program's goal, can be seen in Figure 2.



- **Measure Savings.** Figure 3, below, shows the number of measures installed and savings attributable to those installations. Showerheads accounted for the vast majority of Therm savings. Both faucet aerators and pipe insulation were installed less often and generated a fraction of the Program's gas savings.

[9] Questar Gas Company, filing with the Utah Public Service Commission, recognized11.4 Therms as deemed savings for pipe insulation: http://www.psc.state.ut.us/utilities/gas/05docs/05057T01/QGC%20DSM%20Exhibit%201.11%20(Sources)12-5-06.doc



Review Results

- **Program Documentation Review.** In reviewing program documentation, we found documentation the Program maintained on each project was typically complete and accurate, with the database matching records on file.

  Only two sites had incomplete documentation or entries that did not match the database. One project was completed early in the Program, just after its launch and while the database was still under construction. The other project suffered from a property manager returning messy and confusing data entry sheets, with one site not matching the database due to a missing pipe insulation entry and another with a difficult to verify a pipe insulation measure. However, based on the documentation available, Cadmus believes documentation largely corresponded to the database.

- **Engineering Review.** As noted, our review or gas measure assumptions found the deemed savings value for pipe insulation too high and should be decreased from 30 to 11.4 Therms.

- **Evaluability Assessment.** Our evaluability assessment pertaining to gas measures revealed that many data elements needed for evaluation are being tracked by the Program, and most of the data is housed in the Program's database. However, a few additional, required data elements should be tracked by Program implementers and should be included in the electronic database to ensure Cadmus can fully calculate Program impacts for PY2 and PY3. Gas data elements missing from the program database include: water heat fuel type, space heat fuel type, and common area AIU gas account numbers.

Table 1, below, lists all data elements and indicates: if the database tracks it; if program forms capture the information; and if the data element needs to be added to the program database.

Table 1. Data Collection

Required Data for Evaluation	Tracked in Database?	Field Exists on Participation Forms?	Should be Added to Program Database
Water heat fuel type	No	Yes	X
Space heating fuel	No	No	X
All facility and building addresses	No	No	X
All common area AIU electric account numbers	No*	No*	X
All common area AIU gas account numbers	No*	No*	X
In-unit measures installed by type and quantity	Yes	Yes	
Number of treated buildings	Yes	Yes	
Total number of buildings at the facility	No	No	X
Number of treated units	Yes	Yes	
Total number of units in each building	No	No	X
Total square feet of building and facility	No	No	X
Custom measures energy audit	N/A PY1	N/A PY1	X
Property owner/manager name and contact information	Yes	Yes	
Installer Name	No	Yes	X
Installer contact information	No	Yes	X
Names and contact information for all program allies	Yes	Yes	

*One facility account number is tracked; all common area account numbers should be tracked.

The three noted data elements should be added to the program forms and the program database.

Recommendations

Institution of the following recommendations will help the Program continue its success over the next two program years. Further program recommendations can be found in the *Multifamily Buildings Program Evaluation*, which focuses on electric issues.

- **Complete database rollout and include fields capturing data necessary for program evaluation**. Completing the tracking database will benefit all parties involved with the Multifamily Program. It will allow CSG staff to more easily track the Program and report on its progress. The database also will aid AIU staff in quickly generating reports as needed. Incorporating the data fields Cadmus has requested into the database (as highlighted in Table 1), including water heat fuel type, space heat fuel type, and common area AIU gas account numbers, will ensure ease and accuracy in conducting the Program's impact evaluation.

- **Launch the Program's custom measures component in PY2.** Account managers have found participants had little knowledge of energy efficiency (in general) or how it could be applied to their buildings (in particular). Cadmus encourages the Program to begin performing complete building energy audits to determine where property owners can generate savings for themselves and their tenants. Assessing a building only once and determining how many measures apply would be more time-effective than visiting a building several times and duplicating the energy analysis.

As CFLs become the most common lighting technology available**,** lifetime savings from these measures will diminish, threatening the Program's cost-effectiveness. If the Program becomes well-versed in delivering more complex measures early on, it will not experience as steep a learning curve as it would launching those measures later in the Program. While we recognize educating Program participants about the need for installing other measures may be difficult in a new market, where people have limited information on energy efficiency and its benefits, we believe failing to do so will inhibit the Program's efforts to meet its PY3 goals.

- **Continue consistent communication**. In PY1, AIU and CSG staff maintained good, consistent communication between parties—a valuable asset to both parties and noted several times by AIU staff as a great benefit. The collaboration and trust between parties in launching the Program contributed to the Program's successful first year. A particularly important activity seems to have been joint field work, which gave AIU staff an opportunity to appreciate the caliber of CSG's field staff, while providing a first-hand understanding of how the Program operates.

Table 2 summarizes the impact results from PY1 Multifamily Program.

Table 2. PY1 Multifamily Gas Measures Results

Table 1: Program Year 1 Gas Program Measures installed and Savings Achieved			
Measure	**Quantity Installed**	**Gross Therm Savings**	**Net Therm Savings**
Faucet Aerator	2,535	2,931	1,954
Pipe Insulation	886	1,653	1,322
Showerhead (2.0 GPM)	1,937	35,957	28,064
Total	**5,358**	**40,541**	**31,340**

APPENDIX B. HEP ANNUAL RESULTS

PY3 Results

Date: **April 17, 2012**

To: **Karen Kansfield, Ameren Illinois**

From: **Sandra Brown, The Cadmus Group, Inc.**

Re: **HEP PY3 Gas Impact Evaluation**

Introduction

Implemented by Ameren Illinois' subcontractor, Conservation Services Group (CSG), the Home Energy Performance (HEP) Program is a diagnostic and improvement program offered to Ameren Illinois' residential customers for a fee of $25. CSG Energy Advisors conduct an "HEP Audit" of participant homes, which includes installing instant savings measures (ISMs) such as compact fluorescent light bulbs (CFLs) and domestic hot water (DHW) measures (faucet aerators, energy efficient shower heads, and water heater pipe insulation). Throughout the HEP Audit, Energy Advisors educate the homeowner on savings possible through shell measures such as air sealing, wall insulation, and attic insulation. Energy Advisors also recommend HEP Program Allies (Ameren Illinois-approved insulation contractors) that offer incentives and can install shell measures.

In a previous report,[10] Cadmus reported on the results of tasks completed for the Program Year 3 (PY3) evaluation (June, 2010 – May, 2011), shown in Table 1. This previous report included the impact evaluation of the electric savings only. **The purpose of this memo is to provide the impact evaluation of the PY3 gas savings portion of the HEP Program**.

Table 1. Summary of PY3 HEP Evaluation Tasks

Action	Impact	Process	Details
Stakeholder Interviews		✓	Provided insight into program design and delivery (n=2); group included program management and implementation contract staff, as well as insulation installers.
Impact Calculations	✓		Revised unit savings estimates for DHW measures, and reviewed shell measures (through simulation models), and lighting measures (through secondary research).

During PY3, the Warm Neighbors Cool Friends (WNCF) pilot program offered incentives to Ameren Illinois customers in the Decatur vicinity who were at 200% to 300% of the federal poverty level. The WNCF pilot combined the Ameren Illinois incentives with grants provided by the Energy Assistance Foundation, a 501(c) nonprofit based in Decatur. The program provided participants free home diagnostic audits and assistance to install energy-saving shell measures in

[10] Home Energy Performance Electric Program Evaluation—PY3.

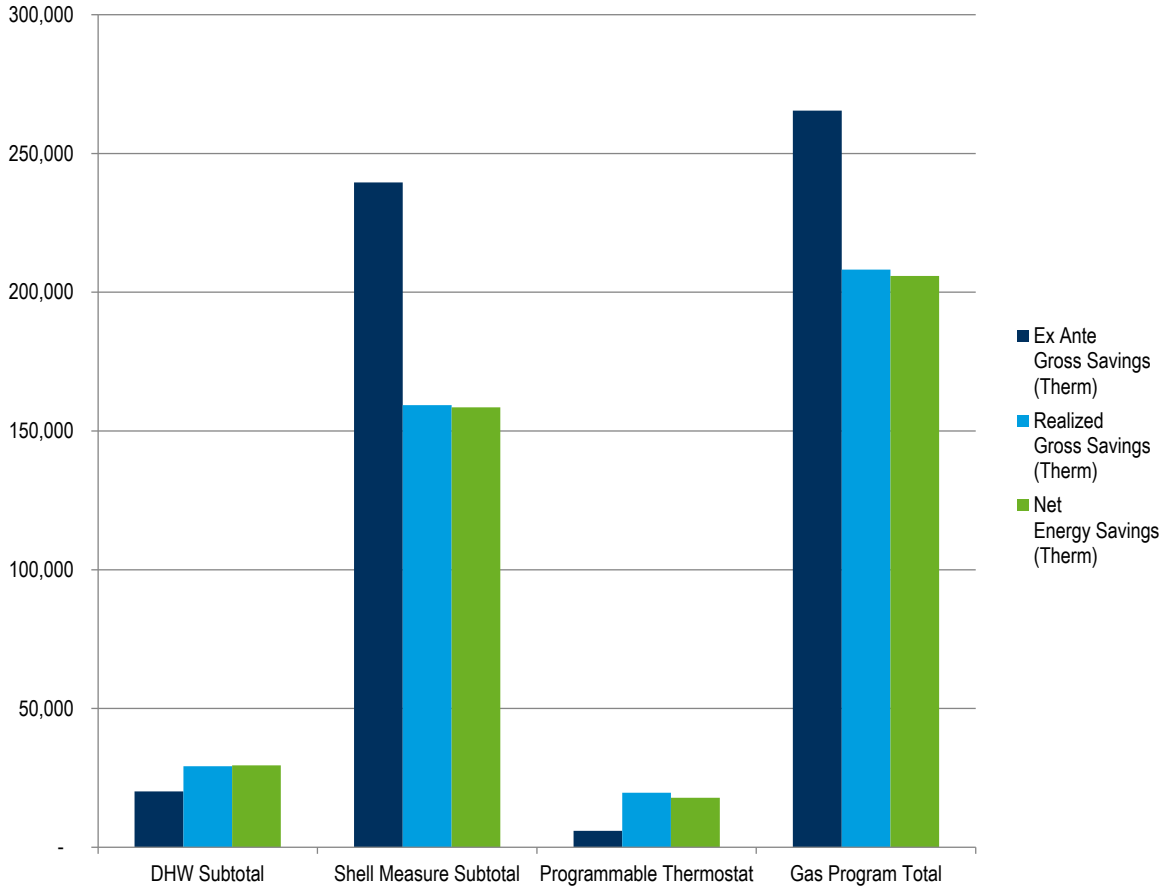
their homes. Participants who installed shell measures were required to pay only $500 or 10% of total project costs, whichever was greater. Of participants who received free audits through the pilot program, 80% went on to install incented shell measures. In Program Year 4 (PY4), the pilot will be rolled out as an independent offering.

Impact Findings

A summary of the gross savings is shown in Figure 1 and summarized as follows:

- Total *ex ante* gross savings are 265,494 therms, derived by multiplying the number of installed measures by *ex ante* unit savings provide by AIU.
- After calculating our own realized unit savings, Cadmus derived an estimate of realized gross savings—208,125 therms—for a realization rate of 78% (see Figure 1).
- Using freeridership and spillover values estimated from participant surveys and secondary research, realized net savings (with spillover) are 205,854 therms. Net savings (with spillover) are gross savings reduced by the percentage of participants reporting that they would have purchased the efficient measure without the incentive (freeridership) plus an estimate of the number of additional savings measures taken as a result of the audit (spillover). The Net to Gross (NTG) ratio is 99%.

Figure 1. PY3 *Ex Ante*, Realized Gross, and Net Realized Savings for the HEP Gas Program



Impact Calculations

For the evaluation of PY3 activities, Cadmus updated impact calculations using per-unit realized savings numbers originally developed during the PY2 evaluation. Cadmus revisited per-unit savings estimates for two DHW ISMs—showerheads and aerators—and found them to be higher than previously estimated in PY2. Please see a previous report for more details. Table 2 identifies sources of savings estimates used in the PY3 evaluation.

Table 2. Savings Estimate Sources

Savings Estimate	Sources
Faucet Aerators	Memo: Domestic Hot Water Savings Revisions, September, 12, 2011 (Appendix A)
Low-Flow Showerheads	
Hot Water Pipe Insulation	Memo: DSH Savings Analysis, February 9, 2011 (Appendix B)
Air Sealing	Energy10 Building Simulation Modeling. See PY2 Gas Evaluation Report.
Attic Insulation (R-7 to R-38)	
Attic Insulation (R-11 to R-38)	
R-11 Wall Insulation	
Thermostat	
Net-to-Gross	Combination of Participant Survey in PY2 and secondary research.

DHW Measures

For the review of aerator and showerhead unit savings estimates, Cadmus examined 10 other aerator and showerhead savings estimates. This analysis led to the following revised savings estimates:

- Aerators: 2.6 therms
- Showerheads: 16 therms

The revised estimates departed from throttling equations used by CSG, resulting in a higher flow number for both energy-efficient and standard DHW measures. (See Ameren Illinois Home Energy Performance Electric Program Evaluation Program Year 3, Appendix A: Domestic Hot Water Savings Revisions for the memo describing revised calculations.)

All other impact savings estimates use the realized unit savings as determined and described in the PY2 evaluation report.

Summary of Program Participation

Table 3 highlights the following changes in program participation compared to PY2:

- Incentives for shell measures, including air sealing and attic and wall insulation, increased dramatically from PY2 to PY3, from 134 to 740.
- The number of programmable thermostats installed increased from 125 to 293.
- The total number of HEP audits completed during PY3 fell to 1,888, down from 2,987 in the previous year.
- The number of instant savings measures installed during HEP audits also fell, from 4,624 domestic hot water measures to 2,465.

Table 3. HEP Gas Program Participation

HEP Gas Program Measure	PY3 Participation	PY2 Participation	PY1 Participation
Home Energy Audits in Total	1,888	2,987	769
DHW Measures Installed in Homes with Gas Water Heaters	2,465	4,624	1,454
Shell Measures Installed in Homes with Gas Heat	740	134	0
Programmable Thermostats Installed in Homes with Gas Heat	293	125	1

Determination of Gross Savings

Table 4 shows the number of installed measures, *ex ante* and realized unit savings, and total gross savings. The total *ex ante* gross gas savings based on program participation was 265,494 therms and total realized gross gas savings were 208,125 therms -- for a gross realization rate of 78%. This reduction in gross savings was driven by the lower unit savings estimates for the shell measures. By measure, the gross realization rate varied from 26% for low-flow showerheads to 335% for programmable thermostats. Savings generated by the WNCF pilot program are included in Table 4 totals.

Table 4. HEP PY3 Gas Program Annual Gross Savings

Measure	Number Installed	Annual Gross Savings				
		Ex Ante Per-unit (Therms)	Realized Per-unit (Therms)	Ex Ante Total (Therms)	Realized Total (Therms)	Gross Realization Rate
Faucet Aerators	661	6	2.6	3,966	1,719	43%
Low-Flow Shower Heads	1705	9	16.0	15,345	27,280	178%
Hot Water Pipe Insulation	87	9	2.3	783	200	26%
DHW Subtotal at 1,821 Homes with Gas Water Heat	*2453*			*20,094*	*29,199*	*145%*
Air Sealing	311	280	196	87,080	61,082	70%
Ceiling Insulation (R-7 to R-38)	10	80	114	800	1,142	143%
Ceiling Insulation (R-11 to R-38)	240	80	75	19,200	17,978	94%
R-11 Wall Insulation	179	740	442	132,460	79,097	60%
Shell Measure Subtotal at 609 Homes with Gas Heat	*740*			*239,540*	*159,299*	*67%*
Programmable Thermostats	*293*	*20*	*67*	*5,860*	*19,628*	*335%*
Gas Program Subtotal	***3,486***			***265,494***	***208,125***	***78%***

Determination of Net Savings

For domestic hot water measures and programmable thermostats, the same net to gross (NTG) ratio was established by using the freeridership values from a PY2 participant survey and 4% spillover. The 4% spillover was established when Cadmus found that seven additional shell measures had been installed by participants themselves without the use of HEP Program allies. The savings from these seven shell measures was considered program spillover. A spillover adjustment for the overall HEP program was determined by: (1) dividing the gas savings from the seven shell measures by the total gas savings of all the other measures installed from the participant survey group and (2) multiplying that value by a 0.5 adjustment factor to account for the uncertainty associated with the measure installation quality and quantity since certified program allies were not used.

For shell measures, Cadmus reviewed the secondary data sources used to establish NTG ratios in the PY2 evaluation. As shown in Table 5, we made three changes to the PY2 estimate for PY3. First, we averaged the three California studies before averaging them with the remaining studies. Since California has a different climate as well as longer running programs, we determined that it would be more appropriate to average the California studies rather than weight California more heavily. Second, we added a recent study from Commonwealth Edison into the average. The result is a slightly higher net of free ridership insulation measures and a slightly lower net of free

ridership for air sealing measures. Finally, we estimated additional spillover (on top of the 4% described above) as documented in the secondary source data.

Table 5. PY3 Net to Freeridership and Spillover Estimated from Other Insulation Program Evaluations

Net of Free Ridership for Ceiling and Wall Insulation	Spillover for Ceiling and Wall Insulation	Source
74%	41%	NYSERDA Report: New York's System Benefits Charge Programs , Evaluation and Status Report, Final Report, March 2010, Table 4-10.
90%	7%	Energy Efficiency/ Demand Response Plan: Plan Year 3 (6/1/2010-5/31/2011), Evaluation Report: Single Family Programs, DRAFT Presented to Commonwealth Edison Company, November 9, 2011, Table 6-14
84%		EnergyWise 2008 Program Evaluation, May 24, 2010, p. 43.
70%	*10%*	*Overview of DEER NTFR Update Process for 2006-2007 Programs, Table 3-2.*
53%		*2004/2005 Statewide Residential Retrofit Single-Family Energy Efficiency Rebate Evaluation, CPUC-ID#:1115-04, Table 9-35.*
27%		*Residential Retrofit High Impact Measure Evaluation Report, Prepared For The California Public Utilities Commission Energy Division February 8, 2010 Table 85*
50%		***Average of CA Studies***
69%		WI Focus on Energy Evaluation Home Performance with ENERGY STAR: Insulation Supply-side Study Results and Integration with Participant Findings April 16, 2010, p. 5-4.
73%	**19%**	**Average for Ceiling and Wall Insulation**
Net of Free Ridership for Air Sealing	**Spillover for Air Sealing**	**Source**
100%	0%	WI Focus on Energy Evaluation Home Performance with ENERGY STAR: Insulation Supply-side Study Results and Integration with Participant Findings April 16, 2010, p. 3-7.
92%	7%	Energy Efficiency/ Demand Response Plan: Plan Year 3 (6/1/2010-5/31/2011), Evaluation Report: Single Family Programs, DRAFT Presented to Commonwealth Edison Company, November 9, 2011, Table 6-14
96%	**3.5%**	**Average for Air Sealing**

Table 6 below shows the final calculations of net program savings using the revised NTG (Net of Free Ridership + Spillover). NTG varied from 91% for programmable thermostats to 104% for air sealing and faucet aerators. Overall, net savings were determined to be 205,854 therms, with an overall NTG of 99%.

Table 6. HEP PY3 Gas Net Program Savings

Measure	Gross Realized Total Savings (Therms)	Net of Free Ridership	Spillover	NTG	Net Realized Total Savings (Therms)
Faucet Aerators	1,719	99%	4%	104%	1,782
Low-Flow Shower Heads	27,280	97%	4%	101%	27,539

Hot Water Pipe Insulation	200	93%	4%	98%	195
DHW Subtotal at 1,821 Homes with Gas Water Heat	*29,199*				*29,516*
Air Sealing	61,082	96%	8%	104%	63,348
Ceiling Insulation (R-7 to R-38)	1,142	74%	23%	97%	1,106
Ceiling Insulation (R-11 to R-38)	17,978	74%	23%	97%	17,423
R-11 Wall Insulation	79,097	74%	23%	97%	76,653
Shell Measure Subtotal at 609 Homes with Gas Heat	159,299				*158,531*
Programmable Thermostats	19,628	87%	4%	*91%*	*17,807*
Gas Program Subtotal	***208,125***			**99%**	**205,854**

PY2 Results

Date: **Revised April 17, 2012**

To: **Karen Kansfield, Ameren Illinois**

From: **Robert Huang, The Cadmus Group, Inc.**

Re: **HEP Gas Impact Evaluation Final Revised**

Introduction

Implemented by Ameren Illinois' subcontractor, Conservation Services Group (CSG), the Home Energy Performance (HEP) Program provides home diagnostic and improvements to Ameren Illinois' residential customers for a fee of $25. CSG Energy Advisors conduct an "HEP Audit" of participant homes, which includes installing instant savings measures (ISMs) such as compact fluorescent light bulbs and domestic hot water (DHW) measures (faucet aerators, low-flow showerheads, and water heater pipe insulation). Throughout the HEP Audit, Energy Advisors educate the homeowner on savings possible through shell measures such as air sealing and wall, attic, and duct sealing. Energy Advisors also recommend HEP Program allies (Ameren Illinois-approved insulation contractors) that offer incentives and can install shell measures. In a previous report,[11] Cadmus reported on the results of the task completed in PY2, shown in Table 1. This previous report included the impact evaluation of the electric savings only. **The purpose of this memo is to provide the impact evaluation of the gas savings portion of the HEP Program.**

Table 1. Summary of PY2 HEP Evaluation Tasks

Action	Impact	Process	Details
Participant Survey	✓	✓	Used for verification, calculating freeridership and spillover, and assessing program implementation (n=72).
Stakeholder Interviews		✓	Provided insight into program design and delivery (n=5); group included program management and implementation contract staff, as well as insulation installers.
Program Records Review	✓		Verified the savings attributable to home energy performance (n=68).
Site Visits	✓		A small sample of homes was visited in the second year (and will be visited in the third year) to provide qualitative data on the quality of installations (n=15).
Impact Calculations	✓		Developed unit savings estimates for DHW measures (through engineering analysis), shell measures (through simulation models), and lighting measures (through secondary research).

[11] Home Energy Performance Electric Program Evaluation—PY2.

Impact Calculations

Cadmus employed a variety of techniques to evaluate and re-estimate the *ex ante* unit savings values shown in the PY2 HEP Implementation Plan.

DHW Measures

For the DHW measures, Cadmus used the DHW unit savings we developed through an engineering analysis in January 2010 (provided to Ameren Illinois and summarized in a memo dated February 9, 2011). We developed these savings estimates after the PY2 HEP Implementation Plan, drafted in August 2009. The implementation plan provided the *ex ante* unit savings for this report.

Shell Measures and Programmable Thermostat

We evaluated shell measure unit savings using Energy-10 software[12] to simulate changes in a standard home's insulation measures. Table 2 shows the values for insulation[13] that we used in the model simulations.

Table 2. Insulation Level Assumptions Used in Energy-10 Model

Measure	Baseline Measure Assumption	Installed Measure Assumption	Type of Efficiency Metric
Air Sealing	0.965	0.676	Air Change per Hour (ACH)
Ceiling Insulation High	7	38	R-value of insulation
Ceiling Insulation Low	11	38	R-value of insulation
Wall Insulation	empty wall cavity	R-11 insulation in wall cavity	R-value of insulation
Programmable Thermostat	70 degrees no setback	70 degrees with setback	

For each installed and baseline measure, Cadmus ran two simulations—one home that was oriented north-south and one oriented east-west—and averaged them to estimate the energy use of the measure. The standard home used in the model was two stories and 1,700 square feet, which closely matches the size of the average home for those survey participants installing shell measures in PY2. We used the climate zone for Springfield, Illinois, which best represents the Ameren Illinois service territory. We estimated the average summer thermostat settings of 76.4 degrees Fahrenheit based on indoor temperature data from a metering sample of 30 homes. We set heating thermostat settings to 70 degrees based on participant survey data. Cadmus assumed duct losses to be 30%. The energy use in the home with the installed measure was compared with the baseline measure to estimate savings.

[12] Energy-10 software is a design tool that analyzes and illustrates the energy and cost savings that are achievable through more than a dozen sustainable design strategies. Hourly energy simulations quantify, assess, and depict the benefits of day lighting, passive solar heating, natural ventilation, well-insulated envelopes, windows, lighting systems, mechanical equipment, and more.

[13] We based Air Change per Hour (ACH) values on the results of blower door test infiltration data at each site. We based wall insulation levels on program criteria that allowed only an empty wall cavity to be eligible for wall insulation. We based R-levels for ceiling insulation on a goal of insulating up to R-38 from two different incentive levels; one starting at R-7 and another starting at R-11.

Similarly, we used Energy-10 to simulate the use of programmable thermostat. The home was subjected to a temperature setback[14] so we could calculate the savings associated with a programmable thermostat. This value was then adjusted by 86%—the percentage of people who received programmable thermostats as part of an incentive program and who use the programmable settings.[15]

Impact Findings

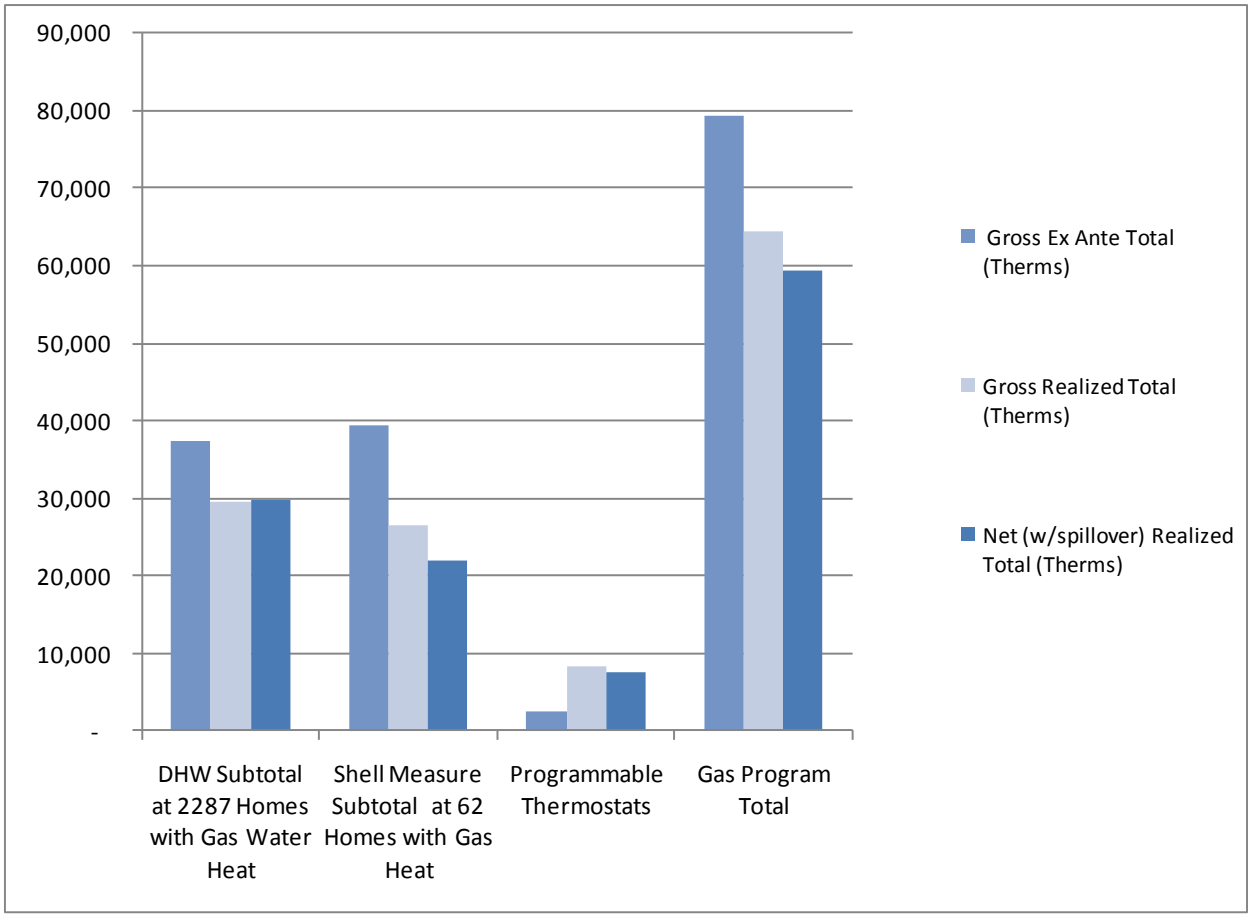
A summary of the gross savings is shown in Figure 1 and summarized as follows:

- Total *ex ante* gross savings are 79,318 therms, derived by multiplying the number of installed measures by *ex ante* unit savings listed in the Residential HEP Program PY2 Implementation Plan, August 28, 2009. Most *ex ante* gross savings were from shell measures.
- After calculating our own realized unit savings, Cadmus derived an estimate of realized gross savings—64,470 therms—for a realization rate of 81% (see Figure 1). Although we determined DHW and shell measures to have lower *realized* unit savings than *ex ante* unit savings, programmable thermostat realized unit savings were substantially higher than *ex ante* unit savings.
- Using freeridership and spillover values estimated from participant surveys and secondary research, realized net savings (with spillover) are 59,633 therms. Net savings (with spillover) are gross savings reduced by the percentage of participants reporting that they would have purchased the efficient measure without the incentive (freeridership) plus an estimate of the number of additional savings measures taken as a result of the audit (spillover).

[14] We based setback temperatures on data gathered during the HVAC evaluation that examined setback temperatures for participants that have programmable thermostats and use their automated settings.

[15] Determined in an unpublished utility program evaluation conducted by Cadmus.

Figure 1. *Ex Ante*, Realized Gross, and Net Realized Savings for the HEP Gas Program



Summary of Program Participation

As shown in Table 3, program participation increased greatly from PY1 to PY2. While the program targeted both gas and electric measures, only gas savings are included in this memo.

- HEP conducted 2,987 audits in PY2, compared to only 769 in PY1.
- In PY2, 4,624 DHW measures—faucet aerators, low-flow showerheads, and hot water pipe insulation—were installed in 2,287 homes with gas heat, compared to only 1,454 DHW measures in PY1. More than half of the installed DHW measures were low-flow showerheads.
- In PY2, 134 shell measures—air sealing, ceiling insulation, and wall insulation—were installed in 73 homes with gas heat, compared to none in PY1.
- In PY2, 125 programmable thermostats were installed compared to only one in PY1.

Table 3. HEP Gas Program Participation in PY 1 and PY2

HEP Gas Program Measure	PY2 Participation	PY1 Participation
Home Energy Audits in Total	2,987	769
DHW Measures Installed in Homes with Gas Water Heaters	4,624	1,454
Shell Measures Installed in Homes with Gas Heat	134	0
Programmable Thermostats Installed in Homes with Gas Heat	125	1

Determination of Gross Savings

For each individual measure, Table 4 shows the number installed, *ex ante* and realized unit savings, unit savings realization rates, and *ex ante* and realized total gross savings. Cadmus evaluated the *ex ante* unit savings, listed in the PY2 HEP Implementation Plan, through engineering calculations for DHW measures and simulation models for shell measures and programmable thermostats. A review of the differences in these unit savings is reflected in the "Unit Savings Realization Rate" shown in Table 4 and is described below. Unit savings realization rates (i.e., *ex ante* unit savings divided by realized unit savings) varied from 26% for hot water pipe insulation to 335% for programmable thermostats.

- For DHW measures, faucets and pipe insulation had the low realization rates of 20% and 26%, respectively. The low-flow showerhead realization rate was much higher, at 118%. As mentioned, the realized unit savings were based on a Cadmus per-unit engineering analysis and were provided to Ameren Illinois in January 2010.
- Ceiling insulation shell measures (for R-7 and R-11 baselines) had realization rates of 143% and 94%, respectively. Realization rates for wall sealing and air sealing were 60% and 70%, respectively. The large variation in realization rates for shell measures points to the fact that that the Energy-10 simulation model and the DOE2-based simulation models we used in the original development of *ex ante* unit savings estimates likely employed different base assumptions and algorithms. For example, examining the documentation regarding the *ex ante* unit savings, Cadmus discovered that the model assumed a reduction of ACH from 0.8 to 0.35. According to program records for sites with air sealing measures, Cadmus established that the true reduction in ACH was from 0.965 to 0.676 ACH. The large difference in the ACH reduction input was the main cause for the difference in realization rates.
- Programmable thermostats had a realization rate of 335%. We based realized unit savings of 67 therms on Energy-10 modeling. Using similar defaults, the ENERGY STAR® programmable thermostat savings calculator provided similar results.

As shown in Table 4, for each measure, we multiplied *ex ante* and realized unit savings by the number of installs to determine *ex ante* and realized total gross savings. Total *ex ante* gross savings are 79,318 therms and realized gross savings are 64,470 therms, for a realization rate of 81%.

Determination of Net Savings

In calculating a net-to-gross (NTG) ratio for the program, the evaluation team conducted a participant survey regarding ISMs, shell measures, and programmable thermostats. The NTG

ratio accounts for the effect of participants reporting that they would have purchased the measures without the benefit of the program. We asked 72 program participants the following series of questions to determine the degree of freeridership for each measure:

- Was the measure installed in your home when you first heard about the program?
- At the time that you first heard about the program, had you already been planning to install the measure?
- Without the program, would you have installed the measure in your home on your own?
- Without the program, would you have installed the same amount of the measure in your home?
- Without the program, would you have installed the measure at a different time, and if so, when?

As shown in Table 4, freeridership varied greatly between measures. The freeridership for each DHW measure was between 3% and 13%; most participants told us that installing aerators, low-flow showerheads and insulating pipes and purchasing programmable thermostats would not have happened without the HEP Audit Program.

For insulation measures, Cadmus recognized that estimating freeridership would be challenging because of the influence of the federal tax credit for energy-efficient insulation measures (30% of the costs, up to $1,500). When asking participants about their probable purchasing habits without the program incentive, we understood that participants might not be able to separate the effect of the Ameren Illinois discount from the influence of the tax credit. While we attempted to isolate the Ameren Illinois program effects, our survey results were inconclusive because participants do not make purchasing decisions for individual components, but rather on the full incentive package.

Without reliable participant survey results, Cadmus conducted secondary research and examined other recent insulation program evaluations and their estimates of freeridership. As shown in Table 5, Cadmus found an average of 37% freeridership from other studies of ceiling and wall insulation, and zero freeridership for air sealing.

During the participant survey, Cadmus found that seven additional shell measures had been installed by participants themselves without the use of HEP Program allies. The savings from these seven shell measures was considered program spillover. A spillover adjustment for the overall HEP program was determined by: 1) dividing the gas savings from the seven shell measures by the total gas savings of all the other measures installed from the participant survey group and 2) multiplying that value by a 0.5 adjustment factor to account for the uncertainty associated with the measure installation quality and quantity since certified program allies were not used. The estimated program spillover adjustment was 4%. As shown in Table 4, the total realized net savings (with spillover) are 59,633 therms and program NTG ratio was 92.5%.

Table 4. HEP Gas Program Annual Gross and Net Savings

Measure	Number Installed	Annual Gross Savings					Annual Net Savings	
		Ex Ante Per Unit (THM)	Realized Per Unit (THM)	Unit Savings Real. Rate	Ex Ante Total (THM)	Realized Total (THM)	NTG	Realized Total (THM)
Faucet Aerators	1406	6	1.2	20%	8,436	1,687	104%	1,749
Low-Flow Shower Heads	2456	9	10.6	118%	22,104	26,034	101%	26,281
Hot Water Pipe Insulation	762	9	2.3	26%	6,858	1,753	98%	1,712
DHW Subtotal at 2287 Homes with Gas Water Heat	*4624*				*37,398*	*29,473*		*29.742*
Air Sealing	61	280	196	70%	17,080	12,485	104%	12,483
Ceiling Insulation (R-7 to R-38)	0	80	114	143%	-	-	67%	-
Ceiling Insulation (R-11 to R-38)	48	80	75	94%	3,840	3,596	67%	2,409
R-11 Wall Insulation	25	740	442	60%	18,500	11,047	67%	7,400
Shell Measure Subtotal at 62 Homes with Gas Heat	*134*				*39,420*	*26,623*		*22,294*
Programmable Thermostats	*125*	*20*	*67*	*335%*	*2,500*	*8,374*	*91%*	*7,597*
Gas Program total	***4,883***				***79,318***	***64,470***		***59,633***

Table 5. Freeridership Estimated from Other Insulation Program Evaluations

Freeridership for Ceiling and Wall Insulation	Source
26%	NYSERDA Report: New York's System Benefits Charge Programs, Evaluation and Status Report, Final Report, March 2010, Table 4-10.
16%	EnergyWise 2008 Program Evaluation, May 24, 2010, p. 43.
30%	Overview of DEER NTFR Update Process for 2006-2007 Programs, Table 3-2.
47%	2004/2005 Statewide Residential Retrofit Single Family Energy-Efficiency Rebate Evaluation, CPUC-ID#:1115-04, Table 9-35.
73%	Residential Retrofit High Impact Measure Evaluation Report, Prepared for the California Public Utilities Commission Energy Division, February 8, 2010, Table 85.
31%	WI Focus on Energy Evaluation Home Performance with ENERGY STAR: Insulation Supply-side Study Results and Integration with Participant Findings, April 16, 2010, p. 5-4.
37%	**Average for Ceiling and Wall Insulation**
Freeridership for Air Sealing	**Source**
100%	WI Focus on Energy Evaluation Home Performance with ENERGY STAR: Insulation Supply-side Study Results and Integration with Participant Findings, April 16, 2010, p. 3-7.

PY1 Results

Date: **November 5, 2009**

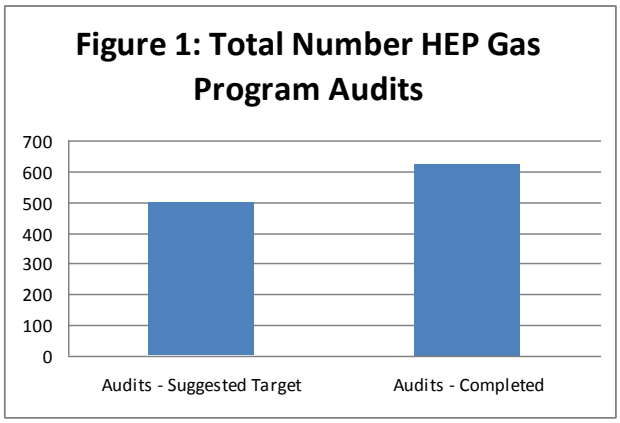
To: **Karen Kansfield**

From: **Robert Huang**

Re: **Review of HEP Gas Program PY1**

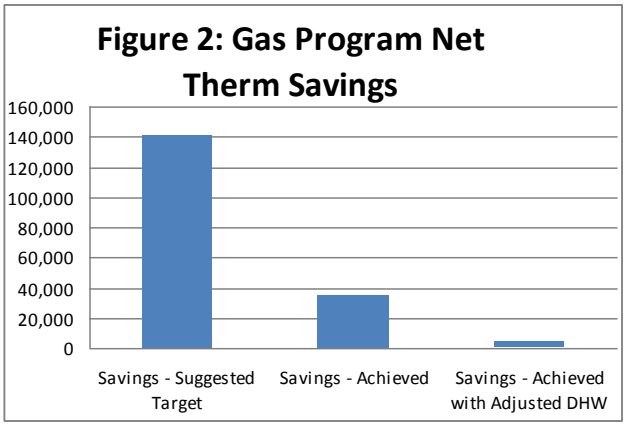
The Home Energy Performance (HEP) Gas program is a home diagnostic and improvement service offered to AIU's residential customers for a $25 fee. This program is the newest of the four residential programs started in PY1; the initial audits started in early 2009. During home audits, Conservation Services Group (CSG) auditors install several domestic hot water (DHW) "instant saving" measures (ISMs) and then recommend incented insulation and HVAC measures (to be installed by HVAC and HEP Insulation Program Allies). Incented insulation measures included air sealing, ceiling insulation and wall insulation. Cadmus conducted a review of default[16] and audit-based gross savings and compared suggested gas program savings targets to savings achieved. For a full review of the HEP Electric Program, including the results of the process interviews with program implementers (AIU and CSG personnel) to determine what did and did not work for HEP in Program Year 1 (PY1), please see the report entitled "Home Energy Performance Electric Program Evaluation." The HEP Gas Program had very similar results to the HEP Electric program. They are summarized below:

- Like the HEP Electric Program, the HEP Gas Program met the PY1 suggested target for total number of HEP audits (see Figure 1, below and Table 1 in the Appendix) at home with gas heat and reflects the fact that the program was well-run.



[16] The term "default" savings represents the savings values used in the AIU "Energy Efficiency and Demand-Response Plan" ("Plan") filed November 15, 2007 and approved by the Illinois Commerce Commission as reflected in its Order dated February 6, 2008. It is recognized that the implementer (CSG) was not responsible for determining default savings. Default savings were determined by a consultant (ICF) who designed the current Plan.

- Similar to the HEP Electric Program, the HEP Gas Program did not meet its suggested program impact targets. Figure 2 shows the difference between the suggested target for program net energy savings of 141,600 therms[17] and two types of achieved program net energy savings. We estimated "achieved net savings" in the second column using the current default savings for DHW to arrive at 34,888 therms. If DHW measure savings are "adjusted" using the results of the CSG audits' gross savings estimates, achieved net savings estimates are reduced to 3,853 therms (see third column in Figure 2). The majority of the difference between suggested targets and savings achieved was due to the complete lack of installation of insulation measures.



- Similar to the HEP Electric Program, the HEP Gas Program did not meet its savings goals because it did not complete any insulation measures in PY1. The goal for PY1 was 325 measures installed (See Table 1 in the Appendix.) There are many possible reasons for this discrepancy. We suspect that the recession was a significant barrier for follow-through on audit recommendations. It is also possible that the incentives were insufficient to move potential participants to the next post-audit phase. As we have not conducted any surveys with audit participants, we are unable to answer the question with confidence. Also, to date, the program has enlisted only three HEP Insulation Program Allies. It is likely that the Building Performance Institute (BPI) certification requirement is a barrier in terms of monetary and time commitment cost.
- Similar to the HEP Electric Program, the HEP Gas Program default gas savings esimates (in therms) for DHW measures (low-flow showerheads, aerators, and pipe insulation) were significantly higher than the gross savings from HEP audits and deemed savings in similar Midwest programs. Furthermore, assumptions used to generate DHW default savings are not well documented. (See Table 2 in the Appendix.)

Based on the results of the HEP Gas Program evaluation, Cadmus recommends HEP enact the following program adjustments, similar to those we suggested after reviewing the HEP Electric Program:

[17] The document "AIU Residential Programs Home Energy Performance Implementation Plan (undated)" calculated this suggested net overall savings suggested target for HEP.

- Examine the possibility of increasing incentives or making them less restrictive to program participants. In this economic climate, program participants are hard-pressed to make investments in HVAC and insulation measures. An analysis needs to be conducted to find out what incentive changes, if any, are feasible (i.e., within the constraints of the Total Resource Cost Test). Cadmus recognizes that these incentive levels may be difficult to change.
- Improve the promotion of shell and HVAC measures to program participants through improved leave-behind written reports and more aggressive follow-up with participants.
- Recruit more HEP Insulation Program Allies by reaching out to them through existing networks, promoting BPI certification training via the Internet, defraying the cost of training, or even consider eliminating the training requirement.
- Evaluate the need for more auditors to improve program coverage.
- Replace default gross savings values for DHW measures with average audit-based gross savings values developed using HEP audit data.

PY1 Results Appendix

Table 1: Program Year 1 Gas Program Measure Net Suggested Target and Actual Savings						
	Quantity		**Net Savings** Based on per unit Default Gross Savings		**Net Savings with Adjusted DHW** DHW Savings from Audit-Based Gross Savings[1]	
	Suggested Target	***Achieved***	***Suggested Target***	***Achieved***	***Suggested Target***	***Achieved***
Audits on Homes with Gas Heat	***500***	***622***	***Therms***		***Therms***	
ISMs at Homes with Gas Hot Water:						
Faucet Aerators Installed	500	750	8,000	12,000	996	1,494
Low-Flow Shower Heads Installed	400	661	12,800	21,152	1,391	2,299
Hot Water Pipe Insulation Installed	400	43	16,000	1,720	409	44
DHW Subtotal	*1,300*	*1,454*	*36,800*	*34,872*	*2,796*	*3,837*
Sites with Gas Heat that Had Installled:						
Infiltration = 0.35 ACH	100	0	22,400	0	22,400	0
Ceiling Insulation (R-38)	100	0	6,400	0	6,400	0
R-11 Wall Insulation	125	0	74,000	0	74,000	0
Insulation Subtotal	*325*	*0*	*102,800*	*0*	*102,800*	*0*
Low-e Double Pane Windows	0		0	0	0	0
Programmable Thermostat	125	1	2,000	16	2,000	16
Gas Program Total	***1,750***	***1,455***	***141,600***	***34,888***	***107,596***	***3,853***

[1] Savings for DHW measures derived from HEP audit-based savings values, see Table 2.

Table 2: Comparison of Default and Audit-Based Gross Savings Estimates					
Gas Furnace Heat	Unit	Per-Unit Default Savings (therms) for AIU (a)	Per-Unit Audit-Based Savings (therms) for AIU (b)	Ratio of Default to Audit-Based for AIU (a/b)	Comments
Wall Insulation	square foot	0.37	0.18	2.07	The default gross savings assume savings from no insulation to R-11. Gross savings estimates from an Iowa utility study estimated 0.137 therms, much closer to the per unit gross savings for AIU.
Duct Sealing	CFM	0.48	0.40	1.19	The default and audit-based gross savings are very close.
Air Sealing	CFM	0.25	0.11	2.32	The default savings calculation assumes a 1,100 CFM_{50} reduction in a standard type of home. The audit-based savings calculations have various different-sized homes with different levels of CPM reductions, number of stories, and HVAC efficiency.
Ceiling Insulation	square foot	0.09	0.23	0.39	Excel Energy data from "Deemed Savings - All Residential Measure for Excel Energy Programs" claims savings of 0.11 therms -- very close to the AIU default savings. The difference may be because the default savings estimates savings going from R-11 to R-38 while the audit-based savings are for a variety of lower starting R-Values.
Thermostat	each	20.00	51.38	0.39	Questar Gas Company in Utah established their deemed savings for programmable thermostats as 26.6 therms annually. (http://www.psc.state.ut.us/utilities/gas/05docs/05057T01/QGC%20DSM%20Exhibit%201.11%20(Sources)12-5-06.doc.) Therefore, AIU default savings seem reasonable. Differences are likely due to different home types.
Faucet Aerators	each	20.00	2.49	8.03	The default savings value for faucet aerators is not accurate. Other deemed savings values are much closer to Ameren Illinois gross savings. PG&E data from "2008 Deemed Values - ComEd" estimated 5 therms for aerators with gas hot water heaters. Excel Energy data from "Deemed Savings - All Residential Measure for Excel Energy Programs" is 2.5 therms for aerators.
Low-Flow Shower Heads	each	40.00	4.35	9.20	The default savings value for low-flow showerheads is not accurate. Other deemed savings values are much closer to Ameren Illinois gross savings. PG&E data from "2008 Deemed Values - ComEd" estimated 6.8 therms savings for low-flow showerheads with gas hot water heaters. Excel Energy data from "Deemed Savings - All Residential Measure for Excel Energy Programs" be 2 to 4 therms per showerhead.
Hot Water Pipe Insulation	each	50.00	1.28	39.10	The default savings value for hot water pipe insulation is not accurate. Other deemed savings values are much closer to Ameren Illinois gross savings. PG&E data from "2008 Deemed Values - ComEd" estimated 6.8 therms savings for hot water pipe insulation with gas hot water heaters. Excel Energy data from "Deemed Savings - All Residential Measure for Excel Energy Programs" be 2 therms for hot water pipe insulation.

APPENDIX C. HVAC ANNUAL RESULTS

PY3 Results

Date: **April 17, 2012**

To: **Karen Kansfield, Ameren Illinois**

From: **Sandra Brown, The Cadmus Group, Inc.**

Re: **PY3 HVAC Gas Impact Evaluation**

Introduction

The Ameren Illinois Heating and Cooling Equipment (Heating and Cooling) Program and Warm Neighbors Cool Friends (WNCF) Program offer incentives to heating and cooling contractors to encourage the purchase of energy-efficient central air conditioners (CAC), air source heat pumps (ASHPs) , ground source heat pumps (GSHPs), gas furnaces, and gas boilers. These programs also included incentives for right-sizing cooling units according to Air Conditioning Contractors of America (ACCA) Manual J through February 12, 2011.

In a previous report,[18] Cadmus reported on the results of the task completed in PY3, shown in Table 1. This previous report included the impact and process evaluation of the electric savings only. **The purpose of this memo is to provide the impact evaluation of the gas savings portion of the HVAC Program.**

Table 1. Summary of Evaluation Tasks for PY3 HVAC Program

Action	Impact	Process	Details
Participant Survey	✓	✓	Assessed freeridership, spillover, the federal tax credit, and program implementation.
Stakeholder Interviews		✓	Provided insight into program design and delivery through interviews with HVAC Program allies, implementers, and managers.
Impact Calculations	✓		Estimated energy savings using energy-simulation models.
Secondary Research	✓		Provided insight into similar program net-to-gross (NTG) ratios in other areas.

Table 2 shows the incentives offered by Ameren Illinois for new gas furnaces and boilers. Depending on the efficiency of the new furnace (95% or 92% Annual Fuel Utilization Efficiency, AFUE), the participant receives an incentive of either $200 or $125. For new gas boilers (90% AFUE) the participant receives a rebate for $500.

Participants of the WNCF program are eligible for higher incentives of $600 for the installation of a new gas furnace (95% AFUE) or $1,000 for the installation of a new gas boiler (90% AFUE). Additional assistance is offered to participations through grants provided by the Energy Assistance Foundation.

[18] Heating and Air Conditioning Electric Program Evaluation—PY2.

Table 2. Summary of Incentives PY3 HVAC Program

Action	Incentive	Details
New Gas Furnace (95% AFUE)	$200	Installing a new gas furnace with a Department of Energy's Annual Fuel Utilization Efficiency (AFUE) rating of 95% or greater.
WNCF New Gas Furnace (95% AFUE) (Beginning in PY3)	$600	Qualify for the WNCF program and install a new gas furnace with a Department of Energy's Annual Fuel Utilization Efficiency (AFUE) rating of 95% or greater.
New Gas Furnace (92% AFUE)	$125	Installing a new gas furnace with an AFUE rating of 92% or greater.
New Gas Boiler (90% AFUE) (Beginning in PY3)	$500	Installing a new gas furnace with an AFUE rating of 90% or greater.
WNCF New Gas Boiler (90% AFUE) (Beginning in PY3)	$1,000	Qualify for the WNCF program and install a new gas furnace with an AFUE rating of 90% or greater.

Impact Calculations

Cadmus updated Energy-10 software[19] simulations, first completed for the PY2 evaluation, to calculate energy savings from installing efficient gas furnaces, and compared those results to the *ex ante* unit savings values from 2008-2010 Ameren Residential Programs, Residential HVAC Program PY2 Implementation Plan. In PY3, we updated the models to calculate energy savings from installing efficient gas boilers.

For the PY3 Energy-10 simulations, Cadmus examined data from the HVAC PY3 database to establish the efficiency of installed gas furnaces and boilers. Table 3 shows the results of this analysis. Baseline efficiency was set at 80% to represent what is available in the market. For other assumptions used in the simulation, including residence size, thermostat settings, and climate data, Cadmus used values established during the PY2 evaluation and based on the program participant survey.

Table 3. Installed Measure and Baseline Energy-Efficiency Data Used in Energy-10 Models

Measure	Baseline Efficiency	Installed Measure Efficiency	Type of Efficiency Metric
New Gas Furnace (95% AFUE)	80%	95.2%	AFUE
New Gas Furnace (92% AFUE)	80%	92.4%	AFUE
New Gas Boiler (90% AFUE)	80%	94.6%	AFUE

Table 4 shows the number of installed measures, *ex ante/realized* unit savings, total gross savings, and total net savings for the gas furnace and boiler measures. The total *ex ante* gross gas savings based on program participation was 1,739,918 therms. After revising unit savings values for the two gas furnace measures based on Energy-10 modeling, we estimated the *realized* gross gas savings at 1,528,070 therms for a realization rate of 88%. This reduction in gross savings was driven by lower realized unit savings estimates than the original *ex ante* unit savings found and reported in the implementation plan and the PY3 database.

[19] Energy-10 software is a home energy simulation tool that analyzes and illustrates the energy and cost savings achievable through different energy-efficient design strategies. Hourly energy simulations quantify, assess, and depict energy savings from measures such as day lighting, passive solar heating, natural ventilation, well-insulated envelopes, windows, lighting systems, and mechanical equipment.

Savings generated by the WNCF pilot program are included include in Table 4 totals. The program installed a total of 23 gas furnaces (average of AFUE 95.1%) and two gas boilers (average AFUE of 92.5%) during PY3.

Table 4. PY3 Gas Gross and Net Savings for HVAC Program

Measure		Annual Gross Savings				Annual Net Savings	
		Ex Ante Per Unit (Therms)	Realized Per Unit (Therms)	*Ex Ante* Total (Therm)	Total Realized (Therm)	NTG	Net Energy Savings (Therm)
New Gas Furnace (92% AFUE)	312	161	146	50,232	45,543	102%	46,454
New Gas Furnace (95% AFUE)	8,539	194	171	1,656,566	1,462,223	102%	1,491,467
New Gas Boiler (90% AFUE)	144	230	141	33,120	20,304	101%	20,507
Gas Program Total	8,995			***1,739,918***	***1,528,070***		***1,558,428***

Impact Findings – Net Savings

For the PY3 evaluation, Cadmus used three surveys of participating contractors, non-participating contractors, and participating customers to establish freeridership and spillover. We calculated the net-to-gross (NTG) ratio according the following formula:

$$NTG = 1 - Freeridership + Spillover$$

Using the survey results, Cadmus analyzed freeridership using five different methods, considering the views of contractors and participants. After reviewing and comparing the results of each method, we chose the results from the participant customer survey as being the most valid to estimate freeridership, which had a value of 47% and 46% for furnaces and boilers, respectively.

Two sources of spillover were also estimated for the PY3 evaluation:

1. ***Additional energy-efficiency purchases by customers who received a program incentive.*** These additional energy-efficiency purchases had to be: (a) strongly influenced by the customer's participation in this program, and (b) not incentivized through another Ameren Illinois program. This spillover was estimated through the participating customer survey. This spillover amount from the gas HVAC measures installed, included a variety of measures savings for both gas and electricity. Therefore spillover was calculated in BTUs and estimated at 14% and 15% of program savings for furnaces and boilers, respectively.

2. ***From customers who purchased energy-efficiency HVAC equipment through a nonparticipating contractor.*** This might have occurred because a number of nonparticipating contractors originally signed up for the program then dropped out, but are still promoting the higher efficiency units to their customers. We interviewed these "drop out" contractors to assess how many additional high-efficiency units were sold due to Ameren Illinois' program. The result was an additional 34% and 32% of program

savings for furnaces and boilers, respectively.[20] Contractors installing gas furnaces reported that the percentage of high efficiency units was significantly higher than it would have been had they not participated in the program.

Combining freeridership and spillover resulted in a total NTG of 102% and 101% for furnaces and boilers, respectively.

[20] While the spillover percentage of program savings estimated for gas measures of approximately 34% is much higher than the similarly computed electric program spillover from non-participant contractors (6%), the reason is due to the smaller total savings of the gas program relative to the electric program. Non-participant spillover is computed by applying the difference in predicted percentage of high efficiency units sold to the average product sales and the drop-out contractor's population, multiplied by estimated savings per unit. This additional spillover amount is then divided by total program savings to estimate spillover percentage. The spillover amount on the gas side is a greater portion of program savings relative to electric. Responses by non-participant contractors were similar between gas and electric measures. We also note that due to the small sample size and large variation of responses, the precision around this spillover estimate is +- 89%.

PY2 Results

Date: **March 8, 2011**

To: **Karen Kansfield, Ameren Illinois**

From: **Robert Huang, The Cadmus Group, Inc.**

Re: **HVAC Gas Impact Evaluation**

Introduction

Ameren Illinois' Heating and Cooling Equipment Program (HVAC Program), implemented by Conservation Services Group, launched in Program Year 2 (PY2), which ran from June 1, 2009 to May 31, 2010. The HVAC Program provides incentives to encourage the purchase of energy-efficient central air conditioning, air source heat pumps, ground source heat pumps, and gas furnaces. The program also includes an incentive for correctly sizing HVAC units according to Air Conditioning Contractors of America Manual J. In a previous report,[21] Cadmus reported on the results of the task completed in PY2, shown in Table 1. This previous report included the impact evaluation of the electric savings only. **The purpose of this memo is to provide the impact evaluation of the gas savings portion of the HVAC Program.**

Table 1. Summary of Evaluation Tasks for PY2 HVAC Program

Action	Impact	Process	Details
Participant Survey	✓	✓	Assessed freeridership, spillover, the federal tax credit, and program implementation.
Stakeholder Interviews		✓	Provided insight into program design and delivery through interviews with HVAC Program allies, implementers, and managers.
Program Records Review	✓		Verified program records to evaluate the suitability and quality of data collected.
Field Measurements	✓		Monitored for a period of 4 to 6 weeks to understand the operation of the units over varying conditions. For two selected homes, quality installation information was collected as well.
Impact Calculations	✓		Estimated energy savings using energy-simulation models.
Secondary Research	✓		Provided insight into similar program net-to-gross (NTG) ratios in other areas.

[21] Heating and Air Conditioning Electric Program Evaluation—PY2.

Table 2 shows the incentives offered by Ameren Illinois for new gas furnaces. Depending on the efficiency of the new furnace (95% or 92% Annual Fuel Utilization Efficiency, AFUE), the participant receives either a $200 or $125 incentive.

Table 2. Summary of Incentives PY2 HVAC Program

Action	Incentive	Details
New Gas Furnace (95% AFUE)	$200	Installing a new gas furnace with a Department of Energy's Annual Fuel Utilization Efficiency (AFUE) rating of 95% or greater.
New Gas Furnace (92% AFUE)	$125	Installing a new gas furnace with an AFUE rating of 92% or greater.

Impact Calculations

Cadmus used Energy-10 software[22] to calculate energy savings from installing efficient gas furnaces, and compared those result to the *ex ante* unit savings values from 2008-2010 Ameren Residential Programs, Residential HVAC Program PY2 Implementation Plan. For each measure, Cadmus ran two simulations—one home that is oriented north-south and one oriented east-west—and averaged them to estimate the energy use of the measure.

The standard home used for most measures in the model was two stories and 1,700 square feet, which approximately matches the average home square footage of program participants responding to the Participant Survey. We calculated sizes of the gas furnaces by taking the average of the installed units from the HVAC PY2 database. We used the climate zone for Springfield, Illinois, which best represents the Ameren Illinois service territory. Heating thermostat settings were set to 70 degrees based on participant survey data.

Cadmus examined data from the HVAC PY2 database to establish the efficiency of installed gas furnaces. Table 3 shows the results of this analysis. Baseline efficiency was set at 80% to represent what is available in the market.

Table 3. Installed Measure and Baseline Energy-Efficiency Data Used in Energy-10 Models

Measure	Baseline Efficiency	Installed Measure Efficiency	Type of Efficiency Metric
New Gas Furnace (95% AFUE)	80%	95.1%	AFUE
New Gas Furnace (92% AFUE)	80%	92.6%	AFUE

Table 4 shows the number of installed gas furnace measures, *ex ante/realized* unit savings, total gross savings, and total net savings for the gas furnace measure. The total *ex ante* gross gas savings based on program participation was 1,174,547 therms. After revising unit savings values for the two gas furnace measures based on Energy-10 modeling, we estimated the *realized* gross gas savings at 1,038,401 therms for a realization rate of 88% (see Figure 1). This reduction in

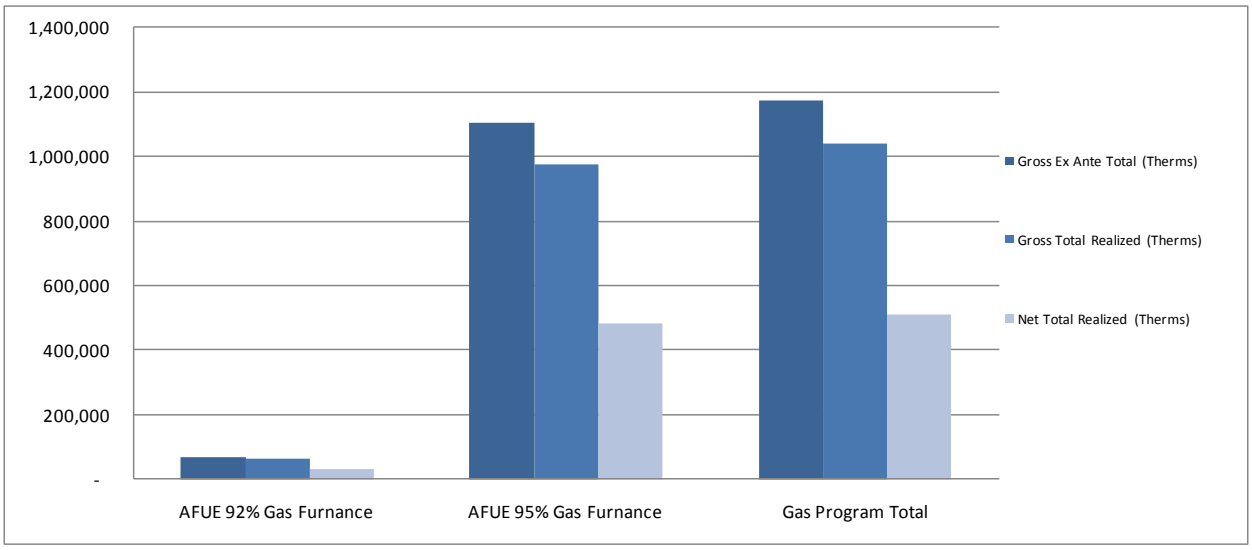
[22] Energy-10 software is a home energy simulation tool that analyzes and illustrates the energy and cost savings achievable through different energy-efficient design strategies. Hourly energy simulations quantify, assess, and depict energy savings from measures such as day lighting, passive solar heating, natural ventilation, well-insulated envelopes, windows, lighting systems, and mechanical equipment.

gross savings was driven by lower realized unit savings estimates than the original *ex ante* unit savings found and reported in the implementation plan.

Table 4. PY2 Gas Gross and Net Savings for HVAC Program

Number of HVAC Measures		Annual Gross Savings				Annual Net Savings	
		Ex Ante Per Unit (Therms)	Realized Per Unit (Therms)	*Ex Ante* Total (Therms)	Total Realized (Therms)	NTG Ratio	Total Realized (Therms)
New Gas Furnace (92% AFUE)	427	161	146	68,747	62,330	49%	30,675
New Gas Furnace (95% AFUE)	5,700	194	171	1,105,800	976,071	49%	480,366
Gas Program Total	**6,127**			**1,174,547**	**1,038,401**	**49%**	**511,041**

Figure 1. PY2 HVAC Program *Ex Ante*, Realized Gross, and Realized Net Gas Savings



Impact Findings – Net Savings

Cadmus recognized that estimating freeridership would be challenging because of the influence of the federal tax credit for energy-efficient HVAC measures (30% of the costs, up to $1,500). When asking participants about their probable purchasing habits without the Ameren Illinois incentive, we understood that participants might not be able to separate the effect of the program discount from the influence of the tax credit. While we attempted to isolate the program effects, our survey results were inconclusive because participants do not make purchasing decisions for individual components, but rather for the full incentive package.

Without reliable participant survey results, Cadmus conducted secondary research and examined other recent HVAC program evaluations and their estimates of freeridership. As shown in Table 5, Cadmus found an average net-to-gross (NTG) ratio of 49% (51% freeridership) from other studies of gas savings in HVAC programs.

Table 5. Net-to-Gross Estimated from Other HVAC Program Evaluations

Net to Gross	Source
34%	HEHE Process and Impact Evaluation Final, October 27, 2010, Table 4-3.
51%	Unpublished evaluation study of a Midwestern utility, 2010.
55%	New Jersey's Clean Energy Program Residential HVAC Impact Evaluation and Protocol Review, June 2009, Table 6-16.
60%	Overview of DEER NTFR Update Process for 2006-2007 Programs, Table 3-2.
39%	Residential Retrofit High Impact Measure Evaluation Report, Prepared for the California Public Utilities Commission Energy Division February 8, 2010, p. 15. (*average of dealer and residential survey)*
69%	Questar Gas ThermWise® Evaluation, September 28, 2010, Table 37.
37%	Piedmont Natural Gas Energy-Efficiency Programs Evaluation: Year One (March–October 2009), Prepared for Piedmont Natural Gas Company, April 22, 2010.
49%	**Average**

We multiplied gross savings by the NTG ratio to establish net savings. As shown in Figure 1 and Table 4 above, realized net gas savings were calculated to be 511,041 therms.

Program Records Review

Cadmus examined 57 High-Efficiency Gas Furnace Program Application forms (Application Forms), representing 57 gas measures, by comparing them to the HVAC database. In addition, we reviewed the invoices that accompanied the Application Forms. Cadmus found several minor data entry errors, including:

- Customer contact information was different in the Application Form compared to the HVAC database in 13 out of 57 reviews. Errors were an incorrect telephone number, customer name, or address.
- One invoice increased (rather than decreased) the total cost of the unit by the value of the incentive.

The AFUE listed in the Application Form did not match the AFUE we found via independent research in four of the 57 reviews. However, none of these errors led to an incorrect rebate amount provided.

APPENDIX D. SB HVAC ANNUAL RESULTS

Impact & Process Evaluation of 2010 (PY3) Ameren Illinois Small Business HVAC Program

Final

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THE CADMUS GROUP

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February 2012

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1. EXECUTIVE SUMMARY

This report presents results from the PY3 evaluation of the Ameren Illinois Act On Energy Small Business HVAC Program. This report contains an impact analysis of only gas savings for the program. Electric savings are reported in the Ameren Illinois Non-Residential Portfolio Report. For the PY3 evaluation of this program, the evaluation team conducted a review of program tracking data, as well as the program implementation plan to assess any changes in program design since PY2. In addition, Appendix A of this report provides detailed findings from the PY2 evaluation effort.

Impact Assessment

Ameren Illinois fell short of their planned Program Year 3 (PY3)[23] energy savings goal for the Small Business HVAC Program. Table 1 provides planned and achieved therm savings.

Table 1. PY3 Small Business HVAC Net Impacts

	PY3 Planned Impacts [a] (Proposed Program Goal)	PY3 Ex Post Net Impacts	% of Goal
	Therms	Therms	
Small Business HVAC Program	901,544	62,393	7%

[a] From Act On Energy Business Program, Program Year Three Implementation Plan, August 24, 2010, Table 2. The original goal was 71,750 Net Therms.

Process Assessment

In PY3, the Small Business HVAC program offering was combined with the Standard HVAC program for implementation purposes. As part of this process, Ameren Illinois included Small Business HVAC measures on the Standard HVAC application and no longer offered a specific application for small business customers. In addition, the program made slight changes to the incentive levels offered for furnace and boiler tune-up measures. Ameren Illinois also planned to expand program marketing and outreach through the use of case studies, although we did not have the opportunity to speak with program allies about their use of these materials.

During the PY3 evaluation process, the team learned that in PY4, Ameren Illinois plans to further simplify the program's incentive structure providing set incentive amounts for specific equipment types as opposed to determining the incentive amount based on kBtuh. This change will address a recommendation made by the evaluation team in PY2.

Report Outline

Section 2 of this report provides the findings from the PY3 evaluation while Appendix A contains the full evaluation report from PY2 for reference.

[23] In the Impact & Process Evaluation of 2010 (PY3) Commercial and Industrial Electric Energy Efficiency Programs, we refer to PY3 as 2010 in executive summary tables. PY3 refers to the period June 1, 2010 through May 31, 2011.

2. PY3 FINDINGS AND RESULTS

This report presents results from the evaluation of the Ameren Illinois Act On Energy Small Business HVAC Program. This report contains an impact analysis of only gas savings for the program. Electric savings are reported in the Ameren Illinois Non-Residential Portfolio Report.

Program Description

The Small Business HVAC program offers Ameren Illinois' small commercial and industrial customers prescriptive incentives to tune-up HVAC equipment, including air conditioners, gas boilers and gas furnaces. In addition, the program provides incentives to replace gas boilers and gas furnaces with energy efficient models. The program requires Ameren Illinois pre-approval before work commences, as well as documentation of project completion through the final application process. Customers may obtain incentives for electric savings and/or gas savings through the program. However, this evaluation effort encompasses only gas savings because electric savings are addressed in a separate report.

Ameren Illinois developed this program to address specific barriers among smaller customers to taking energy efficient actions. In particular, given that HVAC equipment is typically replaced on failure, substantial incentives may be required to entice a facility to upgrade before then, particularly smaller companies with fewer financial resources. Additionally, businesses may not regularly tune-up their HVAC equipment or know about the benefits of doing so. As a result, the program's outreach and incentives serve to educate smaller customers about the importance of maintenance given the often limited staff and staff time to explore energy efficiency upgrade opportunities.

Impact Evaluation

The PY3 ex post gross impact estimates are based on the engineering review performed in PY2 (see Section 0) in which the evaluation team did not recommend any changes to the algorithms currently used to calculate gas savings from the program. Additionally, we applied the Net to Gross Ratio (NTGR) used for program planning as research was not conducted in PY3 on participant decision-making.

Table 2 provides planned and achieved therm savings for PY3.

Table 2. PY3 Small Business HVAC Impacts

	Gross Therms	Net to Gross Ratio	Net Therms
Ex Ante	77,991	0.8	62,393
Ex Post	77,991	0.8	62,393

Source: AIB Extract as of August 23, 2011.

Process Results

The following section outlines the process findings from the evaluation of Ameren Illinois Small Business HVAC program. Overall, the Small Business HVAC program provided incentives to 135 measures in PY3, totaling $92,781.

Table 3. Small Business HVAC PY3 Program Participation

Code	Measure Description	Number of Measures	Ex Ante Gross Therms	Total Incentive
BPH1	Gas Boiler Tune-up	4	6,795	$5,937
BPH2	Gas Furnace Tune-up	36	6,764	$4,715
BPH3	Gas Boiler Replacement (AFUE 85% minimum)	2	643	$529
BPH4	Gas Boiler Replacement (Thermal Efficiency 90%+ minimum)	10	18,166	$22,407
BPH5	Gas Furnace Replacement (Energy Star (90%+ AFUE)	2	389	$320
BPH6	Gas Furnace Replacement (92%+ AFUE)	14	8,356	$10,626
BPH7	Gas Furnace Replacement (94%+ AFUE)	67	36,877	$48,248
Total		**135**	**77,991**	**$92,781**

Program Changes

While the PY3 implementation of the Small Business HVAC Program largely remained the same as in PY2, the program did implement several significant changes:

- **Combination with Standard HVAC Program:** In PY3, Ameren Illinois merged the Standard HVAC and Small Business HVAC applications into one form. The program implementation staff believed that using one form would facilitate outreach and customer awareness.
- **Change in Incentive Levels:** The program reduced the incentive level for gas tune-ups from $0.50 to $0.25 per kBtuh in PY3 given that the program was due to exceed its target number for these types of projects. This reduction was a result of analysis performed by SAIC/GDS and allows the program to stay within their budget while maintaining customer and contractor interest in the measure. These changes in measure level incentives are summarized below in Table 4.

Table 4. Small Business HVAC Incentive Levels for Gas Measures

Code	Measure Description	Incentive Level	
		PY2	PY3
BPH1	Gas Boiler Tune-up	$0.50/kBtuh	$0.25/kBtuh
BPH2	Gas Furnace Tune-up	$0.50/kBtuh	$0.25/kBtuh
BPH3	Gas Boiler Replacement (AFUE 85% minimum)	$1.00/kBtuh	$1.00/kBtuh
BPH4	Gas Boiler Replacement (Thermal Efficiency 90%+ minimum)	$2.00/kBtuh	$2.00/kBtuh
BPH5	Gas Furnace Replacement (Energy Star (90%+ AFUE)	$2.00/kBtuh	$2.00/kBtuh
BPH6	Gas Furnace Replacement (92%+ AFUE)	$2.50/kBtuh	$2.50/kBtuh
BPH7	Gas Furnace Replacement (94%+ AFUE)	$3.00/kBtuh	$3.00/kBtuh

In addition, the evaluation team learned that the program addressed one of the PY2 recommendations in PY4 by simplify its incentive structure to provide a set incentive amount for each type of equipment. Further, based on the PY3 Implementation Plan, Ameren Illinois enhanced marketing and outreach for the Act On Energy HVAC program offerings through the development of case studies and additional collateral.

APPENDIX – PY2 EVALUATION REPORT

Executive Summary

This report presents results from the evaluation of the Ameren Illinois Utilities (Ameren Illinois) Act On Energy Small Business HVAC Program. This report contains an impact analysis of only gas savings for the program as electric savings are reported in the Ameren Illinois Non-Residential Portfolio Report.

Impact Evaluation

Ameren Illinois did not achieve their planned Program Year 2 (PY2)[24] energy savings goal for the Small Business HVAC Program. We believe this is due to lower than expected participation, but are not aware of any specific participation goals at this time. Table 2 provides planned and achieved therm savings.

Appendix Table 1. PY2 Small Business HVAC Net Impacts

	PY2 Planned Impacts[a]	PY2 Ex Post Net Impacts
	Therms	Therms
Small Business HVAC Program	42,060	20,347

[a] From Act On Energy Business Program, Program Year Two Implementation Plan, September 16, 2009, Table 2.

The evaluation team does not recommend any changes to the algorithms currently used to calculate gas savings from the program.

Process Evaluation

There is high satisfaction with the program among both trade allies and program participants. Participating customers not only are pleased with the incentives offered through the program, but also feel well supported by program staff and the trade allies working with them to implement projects. Trade allies also have a positive view of the program and of their relationship with program staff. In addition, participating customers report that trade allies play an important role in their decision to participate in the program.

Based on our assessment of program processes, we make the following recommendations:

- While trade allies report that the program's current marketing materials appear effective, program staff should work with trade allies in PY3 to identify additional marketing tools that would help them reach these small customers. Given the limited time and resources available to small businesses to research energy efficiency opportunities, any additional support the program can provide to direct outreach by trade allies is likely to benefit the program.

[24] In the Impact & Process Evaluation of 2009 (PY2) Commercial and Industrial Electric Energy Efficiency Programs, we refer to PY2 as 2009 in executive summary tables.

- To the extent possible, program staff may want to consider simplifying the program's incentive structure so that a set amount is offered for each type of equipment. Smaller customers with fewer resources may find the program more attractive if there is a higher level of certainty around the incentive amount. Trade allies also believe that this would enhance their advertising and enable them to reach more customers.

Introduction

This report presents the results of the evaluation of the Ameren Illinois Utilities (Ameren Illinois) Act On Energy Small Business HVAC Program. The following sections cover the PY2 process and impact results from the program. To support the evaluation, qualitative research was conducted, including a review of program materials and interviews with program managers, implementation staff, and trade allies. Quantitative research efforts included a survey of an attempted census of customers who participated in the Small Business HVAC Program, and an engineering review of algorithms.

Program Description

The Small Business HVAC program offers Ameren Illinois' small commercial and industrial customers prescriptive incentives to tune-up HVAC equipment, including air conditioners, gas boilers and gas furnaces. In addition, the program provides incentives to replace gas boilers and gas furnaces with energy efficient models. The program requires Ameren pre-approval before work commences, as well as documentation of project completion through the final application process. Customers may obtain incentives for electric savings and/or gas savings through the program. However, this evaluation effort encompasses only gas savings because electric savings are addressed in a separate report.

Ameren Illinois developed this program to address specific barriers among smaller customers to taking energy efficient actions. In particular, given that HVAC equipment is typically replaced on failure, substantial incentives may be required to entice a facility to upgrade before then, particularly smaller companies with fewer financial resources. Additionally, businesses may not regularly tune-up their HVAC equipment or know about the benefits of doing so. As a result, the program's outreach and incentives serve to educate smaller customers about the importance of maintenance given the often limited staff and staff time to explore energy efficiency upgrade opportunities.

Data Sources and Analytical Methods

The assessment of the Small Business HVAC Program included both process and impact analyses.

Process Analysis

The process analysis used data from three data collection methods: depth interviews, secondary data review, and a structured quantitative telephone survey. Depth interviews provided the evaluation team with a comprehensive understanding of the program. We performed depth interviews with one program manager, one implementation contractor, and three trade allies. Additionally, we fielded a Computer Aided Telephone Interview (CATI) survey to Small Business HVAC Program participants. Depth interviews provided context for the report while the CATI surveys were analyzed using descriptive statistics.

Impact Analysis

Gross Impacts

Engineering Algorithm Review

The evaluation team conducted an engineering review to assess the algorithm used to calculate gas savings attributable to the measures incented through the Small Business HVAC program. As part of this process, we first assessed the algorithm used for calculating savings for each of the incentivized measures to make sure that it included all relevant factors. Next, we used engineering judgment to determine if the ex ante (i.e., program value) inputs for the algorithm were reasonable. Lastly, we used survey data responses to see if Ameren Illinois needed to adjust specific inputs.

Net Impacts

The goal of the net impact analysis is to determine the program's net effect on participating customer's gas usage. After gross program impacts are assessed, the evaluation team derives net program impacts by estimating a net-to-gross-ratio (NTGR) based on self-reported information from the CATI survey that quantifies the percentage of the gross program impacts that can reliably be attributed to the program. We calculated NTGRs based on both the level of free-ridership and participant spillover.[25]

Free-ridership

Free-riders are program participants who would have implemented the incented energy efficient measure(s) even without the program. These estimates are based on a series of questions that explore the influence of the program in making the energy efficient installations, as well as a participant's likely actions had the incentive not been available. For all of the projects included in the participant survey, we developed a net-to-gross factor

[25] The analysis described in this section occurred, but was later dropped due to small sample sizes. This is discussed further in Section 4.2.

that consists of three scores: overall influence, influence of program components and influence of program timing.[26]

3. **Overall influence.** This score is based on two survey questions. The first question asked respondents to rate the importance of the program compared to the importance on other factors in their decision to implement the energy efficient equipment. To do so, respondents were asked to divide 100 points between program and non-program factors. The second question asked if they had learned about the program before or after they decided to implement the energy efficient equipment rather than standard efficiency equipment. This score is equal to the number of points given to the program divided by 10. If respondents learned about the program *after* deciding to install energy efficient equipment, that value was halved. Greater importance of the program means lower level of free-ridership.

4. **Influence of program components.** This score is based on a series of four questions. These questions asked respondents to rate the importance of four program components, on a scale of 0 to 10 (where 0 is not at all important and 10 is very important): the incentive amount, program marketing materials, recommendation from program staff, and recommendation from a utility account manager. This score is equal to the highest rating given to any one of these components. Greater importance of the program components means lower level of free-ridership.

5. **Influence of program timing.** This score is developed based on three questions: 1) the likelihood that the exact same equipment would have been installed without the program (on a scale of 0 to 10); 2) when the installation would have been done without the program; and 3) if the installation would have been done later, how much later. This score takes the response to the likelihood question and adjusts this value by the responses to the timing questions. A greater likelihood of participating without the program means higher level of free-ridership. Later implementation without the program means lower level of free-ridership.

Each score can take on a value of 0 to 10, where a higher score means a lower level of free-ridership. The overall net-to-gross factor for a project is the average of the three scores, divided by 10. The net-to-gross factor for each project thus ranges from 0 (100% free-ridership) to 1 (no free-ridership).

A NTGR, weighted by the ex post therms of the surveyed projects, was applied to the population gross impact to obtain a net impact of the program before any spillover was included.

[26] This algorithm is based on the basic rigor self-report method used in California and is the same method used for the ComEd C&I programs.

Spillover

Participant spillover refers to energy efficiency installations that were influenced by the Small Business HVAC Program but did not receive an incentive. An example of participant spillover is a customer, who installed incented equipment in one facility and, as a result of the positive experience, installs additional equipment at other facilities or performs additional efficiency related actions in the same facility because of the program, but does not request an incentive.

Spillover was examined using participant responses to the telephone survey where we asked respondents if they took other energy efficient actions that did not receive rebates and, if so, to rate the influence of the Small Business HVAC Program on their decision to take the action. If the customer indicated a high level of influence (i.e., a rating of 8-10 on a 0-10 scale), we considered this evidence of spillover. While three of the ten participants with whom we spoke, reported taking an additional energy saving action outside of the program, none said that the program was influential in their decision to do so. Based on this data, spillover was not found among program participants in the Ameren Illinois service territory.

Sampling and Survey Completes

CATI Telephone Survey

Opinion Dynamics completed a CATI telephone survey with Small Business HVAC Program participants in July 2010. We attempted to complete the survey with all decision makers in the Small Business HVAC program. The sample frame for this effort is based on program tracking data extracted from Ameren's online tracking database (AIB) and provided on June 10, 2010. Starting with the population of all projects, projects with duplicate contact names were removed, as were customer contacts without phone numbers. The following table summarizes the participant population and completed surveys.

Appendix Table 2. PY2 Completed Small Business Survey Points

AIB Population	Sample Frame Population		Completed Surveys
Projects (Gas Only)	Contacts	Projects	
50	38	45	10

The survey was used to verify program measure installation, gather data to support the NTGR estimation, and collect other information useful for the process evaluation. As we attempted to gather data from a census of program participants installing HVAC measures, the questions regarding the gross impacts or NTGR have no sampling error; therefore, no confidence intervals are applied to the savings.

The evaluation team concluded that an un-weighted analysis for the Small Business HVAC Program provided the best representation for process results. The analysis largely features the reporting of response frequencies, and it was decided to give equal weight to each response.

Trade Ally Depth Interviews

Opinion Dynamics completed depth interviews with trade allies participating in the Small Business HVAC Program. The evaluation team completed interviews with three of the 17 trade allies that completed PY2 gas projects. We conducted the interviews in July 2010.

Results and Findings

Process Results

The following section outlines the process findings from the evaluation of Ameren Illinois Utilities' (Ameren Illinois) Small Business HVAC program.

Program Participation

Customers

In PY2, 164 projects[27] were completed through the Small Business HVAC program. Of these, 50 received gas incentives. Within this gas sub-group, a total of 38 unique commercial customers completed projects, as some companies implemented more than one project.

The customers participating in the Small Business HVAC program come from a variety of industry sectors. Based on responses to the participant survey, the two most common sectors are offices (3/10) and restaurants (2/10). In addition, all surveyed participants own the facility where the project was implemented and are responsible for paying the gas bill, although one rents the facility to a tenant. Further, most of the participating customers operate in older facilities. For example, seven of the 10 facilities are at least 30 years old, while only one was built within the past five to nine years. More than half of the facilities (6/10) are the company's only location.

As expected, since the program targeted small customers, seven of nine respondents who both own and occupy their facility describe their business as small compared to others in their industry, while the remaining two companies consider themselves medium-sized.

Trade Allies

As of August 2010, the Act on Energy Business program had 598 registered program allies. Of these, the Small Business HVAC program manager estimates that about 75 are active specifically in the HVAC market. Among the 50 PY2 gas projects, 47 were completed by 17 contractors, nine of which are registered program allies. The number of completed projects per program ally ranged from one to 30.

Program Awareness

Program Outreach

Ameren Illinois promotes the Small Business HVAC program in a variety of ways, including direct mail to eligible customers, direct mail co-branded with program allies, Chamber of Commerce e-newsletters, and bill inserts. This customer facing outreach, as well as

[27] As of 6/29/2010, of the 50 completed gas projects, 44 received the incentive check, 3 were approved and 3 were pre-approved.

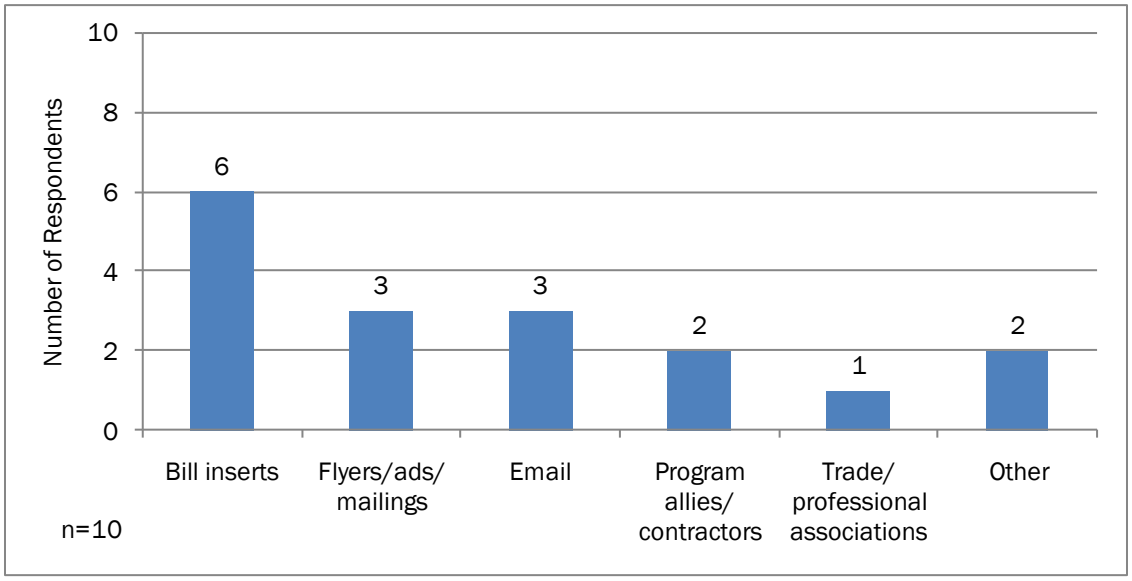
outreach to contractors, appears successful. Six in ten respondents recall seeing or receiving marketing materials about the Act on Energy program. Of those, half first learned about the program from a bill insert.

Recall and Usefulness of Messages

All respondents who recall seeing or receiving marketing materials, found the materials useful in providing information about the Small Business HVAC program. We also asked participants how frequently they felt they heard about the program in order to gauge participant perceptions of the marketing level. Among those participants who recall seeing or receiving information about the program at all, four report they have seen, read or heard about the program somewhat frequently while two respondents heard about the program only occasionally.

In terms of future marketing efforts, participants would most like to receive program information via bill inserts (6/10), flyers (3/10) and email (3/10). Given that these preferences match the way participants currently learn about the program, the program does not need to modify its marketing plan.

Appendix Figure 1. PY2 Participant Preferences for Receiving Information about Energy Efficiency Opportunities (Multiple Response)



In addition to Ameren Illinois marketing materials, program allies promote the program in their own advertisements and report that customers are generally very aware of the program's existence due to marketing from both Ameren Illinois and the contractor.

Outreach to Program Allies and Contractors

Participating program allies generally learned about the Small Business HVAC program through direct contact with program staff. In speaking with them about their experience, the evaluation team also found that these contractors often participate in other HVAC programs, including the Residential HVAC Program and the E-Smart Thermostat Program.

Program Processes

Participation Process and Requirements

The program processes effectively provide incentives to customers. The program requirements and application process are simple, and participants are satisfied with all aspects of the program.

Application Process

Both participating customers and trade allies report that the application process is easy to complete. However, our research found conflicting information regarding who is responsible for filling out the program application. In short, both participants and trade allies report that they filled out the application to participate, which may indicate that both play some role in compiling the necessary information.

More specifically, six in ten participants state that they filled out the application forms (including either the initial or final program application) for the project themselves. Of those that filled out the application, all report that the forms clearly explain the program requirements and how to participate. In addition, half of the participants who filled out the application found completing it "very easy," a rating of 10 on a 10-point scale. The mean rating was 8.3.

Among the trade allies interviewed, all report that they filled out the application. They also describe a process by which the trade ally will often request information from the customer, such as their account number, but complete the technical portion of the application themselves. Based on this experience, the trade allies find the application generally easy to complete. They also note that it is rare for Ameren Illinois to reject applications and if that occurs, the ally simply corrects the error and resubmits the application. Trade allies also report that the wait time for the incentive is usually about one month.

Contact with the Program

Four out of 10 participants contacted the Act on Energy program staff or the Act on Energy Business Call Center in the course of their program participation. In addition, trade allies involved in Small Business HVAC projects also report having regular contact with the program staff for this program, as well as for other HVAC focused programs offered by Ameren Illinois. In particular, questions are most often raised by a trade ally during submission of the pre-approval application.

Customer Satisfaction

Program Administration

Satisfaction with the program and its components is extremely high. As indicated in the table below, participants share a positive perception of the staff's ability to answer questions, the incentive amount, and the program overall among other aspects. Interviews with trade allies active in the program also reveal that they find the program staff very helpful in addressing issues or questions that arise during the course of a project.

Appendix Table 3. PY2 Participant Mean Satisfaction Ratings for Various Program Elements

How would you rate your satisfaction with…?	Overall
The staff's ability to answer your questions	9.0 *(n=4)*
The incentive amount	9.5 *(n=8)*
The program's staff	9.3 *(n=6)*
The measures offered by the program	9.3 *(n=8)*
Act On Energy program overall	9.8 *(n=9)*
Ameren Illinois Utilities	8.1 *(n=10)*

Note: Scale is from 0 to 10 where 0 is "very dissatisfied" and 10 is "very satisfied."

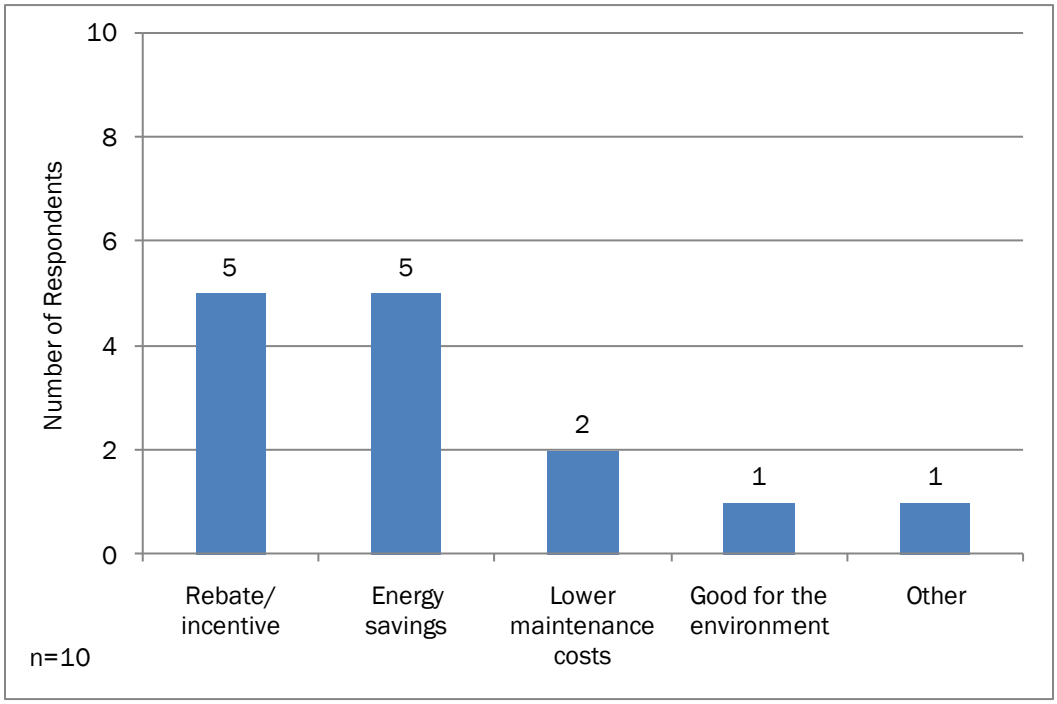
Only two participants experienced any problems during their participation in the program. One had trouble faxing information into the program and the other reported more general problems.

It is also important to note that there is one outlying data point related to satisfaction with Ameren Illinois overall. The relatively low overall rating (8.1) is a result of a single low rating from a customer with outage problems. All other respondents provided high ratings similar to those for the other program elements. This high level of satisfaction is corroborated by trade allies, who perceive participant satisfaction to be high.

Program Benefits

The main benefits cited by participants are the incentive and the energy savings associated with the measures installed through the program. As a result, messaging that stresses the monetary support and energy savings achieved through the program has the potential to resonate with potential participants.

Appendix Figure 2. Main Benefits of Participating in the Program (Multiple Response)



Program Ally and Contractor Performance and Recognition

According to program tracking data, almost all participants (92%) used a contractor for their project. In addition, among survey respondents, all respondents who used a contractor report that their contractor was extremely important in their decision to install high efficiency rather than standard efficiency HVAC equipment (a rating of 10 on a 10 point scale).

Participants feel their contractors did a good job of meeting their needs. For example, participants gave a mean rating of 9.9 when asked to rate their contractor's ability to meet their project implementation needs on a scale of 0 to 10, where 0 is "not at all able to meet their needs" and 10 is "completely able to meet their needs". Not surprisingly, all participants would recommend the contractor to other people or companies.

Although participants think it is somewhat important that their contractor is affiliated with the Act on Energy Business program (mean rating of 7.6), none of the surveyed participants are familiar with the term "Act on Energy Program Ally."

Potential Barriers to Participation

More than half of the program participants (6/10) do not see any drawbacks to participating in the program. Two participants identified drawbacks and mentioned the burden of filing out the paperwork (1/10) and the cost of the equipment installed (1/10).

When customers were asked why other companies are not participating, they cited financial reasons (4/10) and a lack of program awareness (3/10) as the greatest reasons why similar companies probably do not participate. A single participant also cited the lack of awareness of the energy savings generated from the program.

Contractor Suggested Areas for Improvement

Trade allies gave several suggestions to improve the Small Business HVAC program. In particular, depth interviews with program allies reveal that simplifying the incentive structure so that a set amount is offered for each type of equipment instead of basing the incentive on kBtuh would enable them to advertise more effectively to their customers. Given the complexity of the current incentive structure, program allies believe they can only advertise that an incentive is offered by the program, but not a specific dollar amount. In their opinion, offering a specific monetary incentive may generate more sales.

Impact Results

Gross Impact Engineering Analysis

This analysis examines the algorithms used to calculate gas savings attributable to the measures incented through the Small Business HVAC program.

HVAC Algorithm

The following algorithm is used by the program to calculate the energy saved in therms as follows:

$$\frac{therm}{(\frac{kBTU}{hr})} = \frac{HDD \times 24}{65 - ODT} \times \frac{1000\frac{BTU}{kBTU}}{\varepsilon} \times \frac{ESF}{100{,}000\frac{BTU}{therm}}$$

Where:

ESF = energy saving factor (efficiency improvement percentage)

ε = boiler efficiency

ODT = outdoor design temperature[28]

HDD = heating degree days at 65°[29]

The first component on the right side of the equation is equivalent to heating load hours.[30]

[28] ASHRAE Champaign/Urbana 99% Design Temperature

[29] "Typical outdoor average temperature at which a furnace or boiler starts operating (in °F)". Residential Furnaces and Boilers NOPR Technical Support Document from US DOE http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/furnaces_boilers/fb_tsd_appendixm_0906.pdf; The value for heating degree days uses 1980-2006 Statewide averages: http://apps1.eere.energy.gov/states/residential.cfm/state=IL#avgheat

[30] Residential Furnaces and Boilers NOPR Technical Support Document from US DOE

http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/furnaces_boilers/fb_tsd_appendixm_0906.pdf.

Assessment:

The algorithm described above is an accurate model for all algorithms considered in this review. As a result, no change is needed.

HVAC Inputs and Per Unit Savings

The following table outlines the various assumptions and inputs used to calculate savings for the measures incentivized through the Small Business HVAC program.

Appendix Table 4. Small Business HVAC Measure Inputs and Savings

Measure	Size Category	Minimum efficiency requirements	Baseline Efficiency	Baseline Assumption	Efficiency Improvement	Deemed Savings Value (therms/kBtuh)
High Efficiency Gas Furnaces	<300,000 Btu/hr input	EnergyStar Furnace (90+ AFUE)	80%	Program implementer judgment	10%	2.432
		CEE Tier II (92+ AFUE)	80%	Program implementer judgment	12%	2.919
		CEE Tier III (94+ AFUE)	80%	Program implementer judgment	14%	3.405
Boilers (hot water)	<300,000 Btu/hr input	AFUE>=85%	80%	Program implementer judgment	5%	1.216
	>=300,000 Btu/hr input	Thermal Efficiency >= 90%	80%	Program implementer judgment	10%	2.432
Boiler Tune-up	<1,000,000 Bth/hr input	Comply with boiler tune-up program requirements	85%	85% is a "guesstimate" value which is halfway between the boiler code efficiency and the highest efficiency number	2.5% (See below)	0.572
Furnace Tune-up	<300,000 Btu/hr input	Comply with furnace tune-up program requirements	85%	85% is a "guesstimate" value which is halfway between the boiler code efficiency and the highest efficiency number	2.5% (See below)	0.572

Assessment:

The baseline efficiency and efficiency improvement input values are integral to calculating per kBtuh savings. As the two values are tied together, we focused on the efficiency improvement values presented in the table**Error! Reference source not found.** above. Currently, the efficiency improvement input value for both boiler and furnace tune-up is justified by Ameren Illinois Small Business HVAC program staff based on the following logic:

"Efficiency improvement fraction varies. Boilers/furnaces that are tuned regularly and maintained well usually have small efficiency improvements (around 1%). Boilers/furnaces not maintained and not tuned regularly can benefit greatly from tune-ups and can improve efficiency by up to 10%. Boiler/furnace operating hours can vary greatly, especially when equipment is a backup system, or is one of multiple units in an over-sized system. Typical efficiency improvements are in the range of 3 to 5%."[31]

While this logic is reasonable, we used the participant survey data to verify these savings assumptions. For example, we looked carefully at one gas tune-up site to ensure the current approach is logical. The site in question has a 120,000 BTU furnace rated at 90% efficiency. The associated baseline efficiency for this type of equipment is 85% as shown in Appendix Table 4. The evaluation team thinks it is reasonable to assume the efficiency of the furnace has decreased from its rated value of 90% to the assumed baseline of 85%. It is also reasonable to assume an improvement of 2.5% as a result of the program incentivized tune-up. We also believe the reported savings of 68.7 therms for this project is realistic. It is important to note that we reviewed data from other participants in a similar manner and found all of the reported savings reasonable.

We performed a similar assessment of furnace replacements and thermostat set-point (which affect the HDD input value). Survey responses indicate that the average age of replaced furnaces is around 32 years old. As a result, it is reasonable to assume the baseline efficiency of gas furnaces is 80%. In fact, based on typical furnace efficiency 30 years ago and factoring in system degradation, this is a conservative estimate. Furthermore, the average heating temperature set-point of the participants interviewed is 72 degrees. The current algorithm assumes a furnace begins operation at an outdoor temperature of 65 degrees. We believe this value is reasonable for small commercial businesses with a temperature set-point of 72 degrees.

Thus the ex ante inputs and per-unit savings are reasonable and no change is recommended. The ex post gross savings equal the ex ante gross savings.

Net Assessment

As previously discussed, we reached ten of the 38 possible program participants with gas furnaces through our participant survey effort. While this is a good response rate (26%) overall, the fact that we have only ten respondents means that the addition or removal of one or two net-to-gross ratios (NTGR) can easily change the mean NTG value. As a result,

[31] Ameren Illinois Utilities Small Business HVAC Staff (from GDS Associates) email communication. "Small Business HVAC Savings Calculations".

the small sample size makes us less confident about extrapolating the NTG values from the completed surveys to the entire participant population.

To determine the best approach to assessing net savings, we compared the distribution of savings from the sampled participants to the population and found little difference in the savings values. We also looked at the distribution of the net-to-gross values among survey respondents and found that it was skewed low (i.e., six of the responses are between 0.5 and 0.6). In this situation, obtaining even two more survey completes could have changed the NTGR by as much as 11%, depending on the participant responses.

The evaluation team also reviewed participating customer survey responses and found that many appeared confused or provided contradictory responses. As part of next year's evaluation effort, we will modify these questions to elicit better responses. However, as a result of this and the instability due to small sample size, we chose to assign a NTGR of 1.0 for PY2.

Program Level Impact Analysis

Our impact analysis activities yielded an ex post net therm impact estimate equal to the ex ante estimate. Appendix Table 5 below presents the estimates gross impacts, as well as the NTGR and program level net energy impacts attributable to the program.

Appendix Table 5. Small Business HVAC Measure Inputs and Savings

	Ex Ante Gross Therms	Ex Post Gross Therms	Ex Post Net Therms
Program Total	20,347	20,347	20,347
Gross Realization Rate			1
NTGR			1

Note: Realization Rate= Ex Post Value/Ex Ante Value

While we did explore program influence as part of the participant survey effort, we found a good deal of variation in individual participants' NTGRs for the program. As stated in the discussion above, given the small number of respondents, we do not feel comfortable extrapolating the NTGR we found to the program level savings.

Overall, the program did not meet its net therm savings goal of 42,060 therms for PY2. We believe this is the result of lower than expected program participation, but have not seen any formal participation goals at this time. In PY2, 50 projects received gas incentives through the Small Business HVAC program for a total of 53 measures. Although gas forced-air furnace tune-ups accounted for the largest share of measures, replacements of 94 AFUE gas furnaces accounted for the largest share of savings in therms.

Appendix Table 6. Small Business HVAC Measure Inputs and Savings

Measure	Measure Count	Unit Savings (Therms)	Total Savings (Therms)
Gas boiler tune-up	2	0.57	4,315
Gas forced-air furnace tune-up	33	0.57	5,427
Gas boiler replacement	2	2.43	1,180
Gas furnace replacement (92 AFUE)	5	2.92	2,700
Gas furnace replacement (94 AFUE)	11	3.41	6,725
Total	53	N/A	20,347

Source: Program tracking database

Conclusions and Recommendations

Conclusions

Program participants demonstrate high levels of satisfaction with the Small Business HVAC Program. Not only are they pleased with the incentives offered through the program, but they offer praise for both the program staff and the trade allies working with them to implement projects. It also is evident that trade allies play an important role in getting customers engaged in the program.

Impact Recommendations

The algorithm used to calculate gross savings associated with the Small Business HVAC program is acceptable and the evaluation team does not believe that any changes to the current savings estimates are needed. The focus of the evaluation and survey questions were to determine whether the assumptions used in the algorithm were accurate. We found all inputs were reasonable and made no changes to either the algorithm or the inputs for the gross impact effort.

Process Recommendations

Key recommendations related to the program processes are:

- Program Marketing: While trade allies report that the program's current marketing materials appear effective, program staff should work with trade allies in PY3 to identify additional marketing tools that would help them reach these small business customers. Given the limited time and resources available to small businesses to research energy efficiency opportunities, any additional support the program can provide to direct outreach by trade allies is likely to benefit the program. This support may include cooperative marketing such as co-branded brochures or help trade allies to identifying potential participants.

Program Design: To the extent possible, program staff may want to consider simplifying the program's incentive structure so that a set amount is offered for each type of equipment. Smaller customers with fewer resources may find the program more attractive if there is a higher level of certainty around the incentive amount. Trade allies also believe that this would enhance their advertising and enable them to reach more customers.

APPENDIX E. GREEN NOZZLES ANNUAL RESULTS

Impact & Process Evaluation of 2010 (PY3) Ameren Illinois Green Nozzle and Faucet Aerator Programs

Final

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3. EXECUTIVE SUMMARY

This report presents results from the evaluation of the Ameren Illinois Act On Energy Green Nozzles Program and the Direct Install of Faucet Aerators initiative. To support the evaluation, we performed a thorough review of program tracking data, as well as the implementation plan for each program.

Impact Assessment

The Green Nozzles Program instituted a significant ramp down in PY3 with only 148 nozzles installed compared to 1,301 in PY2. In addition, based on the PY2 evaluation report, Ameren Illinois updated the green nozzle algorithm and included an in-use factor to account for the removal of some measures after program participation. However, no changes were made to the measure offered through the Green Nozzle Program.

In contrast, the Direct Install of Faucet Aerators pilot began ramping up half way through the program year with a total of 11 low flow showerhead and 493 faucet aerators installations across 16 unique participants.

Table 5 below presents the energy savings associated with both programs.

Table 5: Green Nozzle and Faucet Aerator Net Impacts

	Ex Ante Gross Impacts	Ex Post Net Impacts
	Therms	Therms
Green Nozzle Program	168,205	137,928
Direct Install of Faucet Aerators	8,547	6,837
Total	176,752	144,765

Process Assessment

In PY3, the Green Nozzle Program was offered as part of the Standard Commercial Kitchen program offering. However, given that the Green Nozzle Program reached a significant portion of its target audience in PY2, the program expected limited levels of activity in PY3.

Over the course of PY3, the program made changes to program processes in response to PY2 recommendations. First, Ameren Illinois added the Green Nozzle Program to its AIB dashboard, which allows for information sharing about program activity in real-time. While year-end participant data was still provided to the evaluation team in independent Excel tracking files, adding the program to the AIB dashboard represents a significant improvement in program tracking given that the Green Nozzle Program was not included in AIB at all during PY2, Second, the program implemented its plans to incorporate Green Nozzles into the Standard Food Service Application.

To provide additional benefits to their business customers, Ameren Illinois also launched the Direct Install of Faucet Aerators pilot initiative in the middle of PY3 to provide faucet aerators and low-flow showerheads to hotels, motels or restaurant facilities that belong to the GDS2 rate class. Ameren Illinois implemented the pilot effort with two waves of

customer outreach and recruitment. Activity was relatively limited with 16 unique participants.[32]

Report Outline

Section 2 of this report provides the findings from PY3 while Section 3 contains the full evaluation report from PY2 for reference.

[32] The team defined unique participants based on gas account number.

4. PY3 RESULTS AND FINDINGS

Green Nozzle Program

Program Description

The Green Nozzles Program is part of Ameren Illinois Small Business Gas Food Service Program (SBF). By installing free low-flow pre-rinse spray nozzles in place of less flow-efficient nozzles, the Green Nozzle Program aims to reduce therms associated with water heating in eligible Ameren Illinois restaurants, commercial kitchens, bar and grills, and other locations that perform food service/food preparation activities. The lower flow rate nozzles use less hot water, and therefore less gas.

The Green Nozzle Program was originally set up as a direct install initiative. However, after installing more than 500 green nozzles in these main geographic areas of East St. Louis, Peoria, and Champaign, program staff realized they needed to expand to other areas of the state in order to meet the program goal, and that expansion made the direct install model less feasible. Through their work on the initial installations, program staff realized that restaurateurs would in fact be able to install the green nozzles with ease. As a result, the program switched to a direct mail model in which the program mails the green nozzles to interested facilities.

Program Changes

In PY3, the Green Nozzle program continued using the direct mail model however green nozzles are now advertised as part of the newly designed Standard Commercial Kitchen program offering.[33] More specifically, the free green nozzle is now listed on the Standard Commercial Kitchen application. In general, this tailored sector specific application offers set incentives to encourage customers to implement best-practice measures by installing energy efficient kitchen equipment.

Similar to PY2, the free green nozzle is still only available to small gas customers (GDS-2 delivery rate) with the goal of replacing less flow-efficient nozzles with low-flow green nozzles in order to reduce the therms associated with water heating. However, given the initiative's success in PY2 and the relatively high saturation of efficient pre-rinse spray valves in many of their eligible customers (GDS-2), in PY3 the level of activity in the Green Nozzle program has subsided dramatically (1,301 nozzles in PY2 vs. 148 in PY3). Ameren Illinois is also using the Green Nozzle program to help with recruitment efforts for the Standard Commercial Kitchen program by targeting prior Green Nozzle program participants.

In response to PY2 recommendations, the program also made changes to data tracking processes. Ameren Illinois added the Green Nozzle Program to its AIB dashboard, which allows for information sharing about program activity in real-time. While year-end participant data was still provided to the evaluation team in independent Excel tracking files, adding the

[33] The PY3 Implementation Plan notes that green nozzles are also available online. However, the team did not find any supporting documentation of this and does not mention it here as a result.

program to the AIB dashboard represents a significant improvement in program tracking given that the Green Nozzle Program was not included in AIB at all during PY2,[34]

Program Level Impacts

In PY3, Ameren Illinois modified the program's green nozzle algorithm, specifically flow rate and days of use assumptions based on the results of the PY2 evaluation. In addition, while the measure provided through the program remained the same, the program included an in-service factor to account for the 18% removal rate among participating customers (also recommended in PY2).

As a result, ex post therm impact estimates equal the ex ante estimates for both gross and net savings as illustrated in Table 6 below.

Table 6: Gross and Net Impacts

	N	In-Service Rate	Per Unit Savings	Gross Therms	Net to Gross Ratio	Net Therms
Ex Ante	148	82%	1,386	168,205	0.82	137,928
Ex Post	148	82%	1,386	168,205	0.82	137,928
			Realization Rate	1.0		1.0

Note: Realization Rate= Ex Post Value/Ex Ante Value

Source: Ameren Illinois PY3 Nozzle-Aerator Lists

Direct Install of Faucet Aerators

Program Description

In PY3, Ameren Illinois implemented a pilot initiative to install faucet aerators and low flow showerheads in facilities that previously received a green nozzle as part of the Green Nozzles Program, as well as hotels, motels or restaurant facilities that belong to the GDS2 rate class. The intent of the pilot is to achieve both gas and electric savings. However, we present only gas impacts in this report (electric impacts are included in the PY3 Ameren Illinois C&I Report).

The pilot sent targeted mailings to recruit customers in two waves. The first wave of outreach featured 1,360 mailers aimed at customers located near Peoria, Quincy, Galesburg, Champaign/Urbana, and Metro East while the second went to 720 customers in Decatur, Springfield, Marion/Carbondale, Mattoon, and Effingham. Interested customers then contacted Ameren Illinois to request these measures and the program supplied trained plumbers[35] with lists of interested customers. These plumbers were responsible for the installation of the measures, and received a combined incentive of $100 per customer site visit and $10 per aerator installed.

[34] The team also understands that the resources needed to add information from this initiative to AIB, as well as the impact that additional data would have on the structure of the database may make further changes impractical.

[35] Program staff expected to use a single plumber from each location for this pilot.

Program Level Impacts

The evaluation team did not conduct a full impact analysis of the Direct Installation of Faucet Aerators Pilot given its small contribution to the overall C&I portfolio. As a result, ex ante impacts are equal to ex post as is illustrated in the following table containing the energy impacts for the pilot

Table 7: Net Energy Impacts – Direct Install Faucet Aerators

Measure Type	N	Gross Therms		NTGR	Net Therms	
		Ex Ante	Ex Post		Ex Ante	Ex Post
Aerators	493	8,071	8,071	0.8	6,457	6,457
Showerheads	11	476	476	0.8	381	381
Total	504	8,547	8,547	0.8	6,837	6,837

Source: Ameren Illinois PY3 Nozzle-Aerator Lists

APPENDIX: PY2 GREEN NOZZLE EVALUATION

We provide the full PY2 evaluation report in the following section to present a complete assessment of the Green Nozzle Program.

Executive Summary

This report presents results from the evaluation of the Ameren Illinois Act On Energy Green Nozzles Program. The Green Nozzles Program is part of Ameren Illinois Small Business Gas Food Service Program. By installing free low-flow pre-rinse spray nozzles in place of less flow-efficient nozzles, the Green Nozzle Program aims to reduce therms associated with water heating in eligible Ameren Illinois restaurants, commercial kitchens, bar and grills, and other locations that perform food service/food preparation activities.

Impact Evaluation

Ameren Illinois exceeded its planned Program Year 2 (PY2)[36] energy savings goal for the Green Nozzles Program.

Table 8: Green Nozzle Net Impacts

	PY2 Planned Impacts[a]	PY2 Ex Post Net Impacts
	Therms	Therms
Green Nozzle Program	508,881	1,213,424

[a] From Act On Energy Business Program, Program Year Two Implementation Plan, September 16, 2009, Table 2.

The Evaluation Team also identified areas for improvement in the current algorithm used for the program. In particular, based on our assessment of impacts, we make the following recommendations:

- Update per Unit Savings: As outlined in Section 0, there is sufficient support for the input changes for us to recommend that the gross per-unit savings be increased to 1386 therms.
- Assume a Removal Rate: The program implementers should assume a removal rate of at least 18% and account for this through the use of an in-service rate of 82%.

Process Evaluation

Overall, both program staff and participating customers are satisfied with the program processes, and satisfaction with the program did not differ based on the structure of program delivery. Therefore, continuing with the direct mail campaign remains the most cost

[36] In the Impact & Process Evaluation of 2009 (PY2) Commercial and Industrial Electric Energy Efficiency Programs, we refer to PY2 as 2009 in executive summary tables.

effective strategy for the Green Nozzle Program in PY3. Additionally, the program staff's plans to add a green nozzle option to the standard food service application is a welcome change for PY3 that will likely help to improve the data tracking process as well.

Despite the program's overall success, measure persistence is a major hurdle in PY2. Almost a quarter of participating customers no longer have their green nozzle installed, and about 10% were extremely dissatisfied with the green nozzle installed through the program.[37] If feasible, switching models or changing the flow-rates of the nozzle, while potentially sacrificing some efficiency, may ultimately lead to greater therm savings as a result of more consistent and sustained use over time.

Key recommendations related to the program processes are:

- Improve the compatibility of current Excel file tracking systems with the program tracking database (called AIB) or create a mechanism by which Green Nozzle Program data is entered directly into AIB as is done with other C&I programs.
- While participants found the application process both easy to understand and complete, Ameren Illinois has already made a change to the commercial food service program application to include a check box for green nozzle requests. This should help improve the data tracking.
- Program staff should consider possible approaches to remedy dissatisfaction with the green nozzles provided through the program. If alternative models are available, the program should determine whether Ameren Illinois can change the equipment offered through the program.

[37] As described in the Program Processes Section, 81% of those dissatisfied felt that the water pressure was not powerful enough to effectively rinse their dishes. We understand from program staff that there may be pre-rinse spray valve options that have lower pressure drops, but that it is possible that the issue relates to the customers' water system design.

Introduction

This report presents evaluation results for Ameren Illinois' Act On Energy Business Green Nozzles Program. The following sections cover the PY2 program process and impact results. To support the evaluation, qualitative research was conducted, including a review of program materials and interviews with program administrators and implementation staff, and an engineering review of algorithms. Quantitative research efforts included a survey of a random sample of customers who participated in the Green Nozzles Program.

Program Description

The Green Nozzles Program is part of Ameren Illinois Small Business Gas Food Service Program (SBF). By installing free low-flow pre-rinse spray nozzles in place of less flow-efficient nozzles, the Green Nozzle Program aims to reduce therms associated with water heating in eligible Ameren Illinois restaurants, commercial kitchens, bar and grills, and other locations that perform food service/food preparation activities. The lower flow rate nozzles use less hot water, and therefore less gas. Overall, the Green Nozzles Program aimed to install 1,670 green nozzles by the end of PY2.[38]

The Green Nozzle Program was originally set up as a direct install initiative. However, after installing more than 500 green nozzles in these main geographic areas of East St. Louis, Peoria, and Champaign, program staff realized they needed to expand to other areas of the state in order to meet the program goal, and that expansion made the direct install model less feasible. Through their work on the initial installations, program staff realized that restaurateurs would in fact be able to install the green nozzles with ease. As a result, the program switched to a direct mail model in which the program mails the green nozzles to interested facilities.

[38] This goal is a combination of the original PY1 (379 nozzles) and PY2 (1,291 nozzles) goals.

Data Sources and Analytical Methods

The assessment of the Green Nozzle programs included both process and impact analyses.

Process Analysis

The process analysis used data from two data collection methods: depth interviews and structured quantitative telephone surveys data. Depth interviews provided the evaluation team with a comprehensive understanding of the program. We performed depth interviews with one program manager and one implementation contractor. Additionally, we fielded a Computer Aided Telephone Interview (CATI) survey with green nozzle participants. Depth interviews provided context for the report while the CATI surveys were analyzed using descriptive statistics.

Impact Analysis

Gross Impacts

Engineering Algorithm Review

We first assessed the algorithm for calculating savings for the measures to be sure that it included all relevant factors. Next we used results from secondary research and engineering judgment to determine if the ex ante (i.e., program value) inputs for the algorithm were reasonable. This effort created per-nozzle impacts. Survey data was used to determine the number of nozzles still in place. We calculated program level impacts by applying the survey-based installation factor to the per-nozzle impacts to obtain gross impacts.

Net Impacts

The goal of the net impact analysis is to determine the program's net effect on participating customer's gas usage. Net program impacts are derived by estimating a net-to-gross-ratio (NTGR) based on self-reported information from the CATI survey. The NTGR quantifies the percentage of the gross program impacts that can reliably be attributed to the program. NTGRs were calculated based on both the level of free-ridership and participant spillover. Spillover occurs when a participant takes additional energy efficient actions outside of any energy efficiency program that are influenced by their participation in the program.

Free-ridership

Free-riders are program participants who would have implemented the incented energy efficient measure(s) even without the program. These estimates are based on a series of questions that explore the influence of the program in making the energy efficient installations as well as likely actions had the incentive not been available. For the majority of projects included in the survey, we developed a net-to-gross factor that consists of two scores: overall influence and influence of program timing.

6. Overall influence. This score is based on two survey questions. The first question asked respondents about their previous purchases of low-flow pre-rinse nozzles. The second question asked whether, if they had not received the nozzle for free from

Ameren Illinois, they would have purchased it on their own. If they had previously purchased a similar nozzle and would have purchased one without the program, program influence is low which means a higher level of free-ridership.

7. **Influence of program timing.** This score is developed based on two questions: 1) the likelihood that the exact same equipment would have been installed without the program (on a scale of 0 to 10) and 2) if the installation would have been done at the same time without the program. This score takes the response to the likelihood question and adjusts this value by the responses to the timing questions. A greater likelihood of participating without the program means a higher level of free-ridership. Later implementation without the program means a lower level of free-ridership.

Each score can take on a value of 0 to 10, where a higher score means a lower level of free-ridership. The overall free ridership factor for a project is the average of the two scores, divided by 10. The NTGR equals one minus the free ridership value. Therefore, the net-to-gross ratio for each project ranges from 0 (100% free-ridership) to 1 (no free-ridership).

A NTGR, weighted by the ex post therms of the surveyed projects, was applied to the population gross impact to obtain a net impact of the program before any spillover was applied.

Spillover

Participant spillover refers to energy efficiency installations that were influenced by the program but did not receive an incentive. An example of participant spillover is a customer who received free equipment, such as a pre-rinse nozzle, at one facility and, as a result of the positive experience, installs additional equipment at other facilities because of the program but does not request an incentive or perform additional efficiency related actions in the same facility.

Spillover was examined using participant responses to the telephone survey through a set of questions asking first whether the customer installed energy efficiency equipment (such as lighting or additional nozzles) at their site for which they did not receive an incentive. If this occurred, we asked about the influence of the program in the installation of this additional equipment. If the customer indicated a high level of influence (i.e., a rating of 8-10 on a 0-10 scale), we considered this evidence of spillover.

We found 222 therms associated with participant action outside of the program that was attributed it to the Act On Energy Business Program. The team estimated savings associated with the installation of an energy efficient water heater, an action taken by one program participant. After applying this spillover, we adjusted the NTGR from 0.81 to 0.82.

Sampling and Survey Completes

CATI Telephone Survey

In July 2010, Opinion Dynamics completed a CATI telephone survey with a random sample of

Green Nozzle program participants. The survey was used to verify program measure installation, gather data to support the NTGR estimation, and collect other information useful for the process evaluation.

The CATI phone survey drew a sample from the Green Nozzle program population to achieve 94 completed phone interviews. The sample frame for this effort is based on program tracking data provided by Ameren Illinois on May 30, 2010. Starting with the population of all projects, projects with duplicate contact names were removed, as were projects with duplicate phone numbers. The phone survey had to target unique contact names or phone numbers (where a contact name was not available) to avoid burdening the respondent with a discussion of multiple projects. A number of businesses submitted projects for multiple locations (e.g. chain stores) and listed a single contact person for all projects. We removed these duplicates from the sample.

The following table summarizes the participant population and completed surveys.

Table 9: Completed Green Nozzle Survey Points

Project Population		Sample Frame Population		Completed Surveys
Unique Accounts	Projects	Unique Accounts	Projects	
1,111	1,121	860	862	94

The evaluation team concluded that an un-weighted analysis for the Green Nozzles program provided the best representation for process results. The analysis largely features the reporting of response frequencies, and it was decided to give equal weight to each response.

Process Results

The Green Nozzles Program is part of Ameren Illinois Small Business Gas Food Service Program (SBF). By installing free low-flow pre-rinse spray nozzles in place of less flow-efficient nozzles, the Green Nozzle Program aims to reduce therm usage in eligible Ameren Illinois restaurants, commercial kitchens, bar and grills, and other locations that perform food service/food preparation activities. Use of a nozzle with a lower flow rate means use of less hot water and gas to heat the water, thus creating therm savings. Overall, the Green Nozzles Program aimed to install 1,670 green nozzles by the end of PY2.[39]

Program Design and Administration

Program Modifications

The Green Nozzle Program was originally set up as a direct install initiative. According to the program manager, Ameren Illinois used this approach for a number of reasons: (1) program staff were unsure if restaurateurs would be able to install the free green nozzles themselves, (2) there was interest in launching the program quickly, and (3) the utility wanted to survey gas customers about equipment usage and their potential interest in other energy efficiency programs. By hiring and training staff to canvass and install the green nozzles in the East St. Louis, Peoria, and Champaign areas, the program could achieve all three objectives. In addition to installing a large quantity of green nozzles during the summer of 2009, installers helped with general program marketing.

However, after installing more than 500 green nozzles in these three main geographic areas, program staff realized they needed to expand to other areas of the state in order to meet their goal, which made the direct install model less feasible. In addition, through their initial installations, program staff realized that restaurateurs would in fact be able to install the green nozzles with ease. As a result, the program switched to a direct mail model in which the program mails the free green nozzles to interested facilities.

Challenges

The Green Nozzle Program is classified as a small commercial business program. Therefore eligible customers must have a GDS-2 gas rate. However, the definition of GDS-2 varies between the different utilities joined under the Ameren Illinois name[40]. This presents challenges in terms of program administration as program staff has to be diligent in making sure facilities are eligible for the program. For example, a company with many locations/franchises wanted to install the nozzles at all of their facilities. However, despite the fact that all of the restaurants are similar in size, only half of them were eligible because of rate class definitions.

In addition to eligibility issues, program staff found that the use of pre-rinse spray nozzles was rarer in eligible facilities than originally thought. As a result, while program staff initially

[39] This goal is a combination of the original PY1 (379 nozzles) and PY2 (1,291 nozzles) goals.

[40] Ameren Illinois is a regulated utility with three operating companies: AmerenCIPS, AmerenCILCO and AmerenIP

anticipated reaching their installation goals in the original target areas using the direct install model, they were forced to expand the program to other areas in the state because they had reached all potential participants.

A final issue for the program in PY2 relates to data entry for program tracking purposes. Unlike all of Ameren Illinois's other energy efficiency programs, Green Nozzle Program information is not directly input into AIB. Instead, line items are tracked in an excel file specific to the Green Nozzle Program. This excel file is then copied/imported into AIB, which is both time consuming and inefficient. Staff plans to include a box on the overall food service application in PY3 where applicants can indicate if they would like to receive a green nozzle. This should help standardize data entry and tracking.

Program Participation

Based on a review of program tracking data, as of May 31, 2010, a total of 1,301 green nozzles had been installed through the program. The majority of the nozzles were installed directly by program staff as opposed to being self installed by the participating customer. Out of 1,110 unique participants, 85% had their nozzles directly installed while 15% installed the equipment themselves.[41] Six participants participated in the program through both channels.

The program tracking data provides facility descriptions for 78% of participating customers. Based on these data, the majority of participants are from full (48%) or limited (44%) service restaurants. Other facility types include establishments that serve alcoholic beverages (6%), assisted living facilities, and hotels or inns (less than 1%).

The participant telephone survey also reveals similar trends. For example, survey responses indicate that customers participating in the Green Nozzle Program are mostly full service sit-down (61%) and fast-food (32%) restaurants. The majority own and occupy their facility (72%) and all are responsible for paying the gas bill.

In addition, most participating customers consider themselves to be small (62%),[42] and 67% of facilities have less than 24 employees. Just under half of the participants (45%) installed the nozzle at one of multiple locations operated by their company. In addition, almost half of participating customers occupy older buildings, and 46%of buildings are more than 30 years old.

Program Awareness

Program Outreach

Overall, 52% of participants first heard of the Green Nozzle Program through a direct walk-in by trained program staff. This is not surprising given that the majority of customers participate in the program through the initial direct install delivery channel. Of those participating customers who had their green nozzle mailed to them (referred to as self

[41] The number of unique program participants is based on unique account numbers provided in the Green Nozzle tracking data provided by Ameren Illinois Utilities on May 31, 2010. Where an account number was not available, the participant was omitted from the tally.

[42] Company size is based on company's perception of themselves relative to other companies.

install), Ameren Illinois' mailings – including both bill inserts (38%) and general mailings (24%) – were the main source of program awareness.

Table 10: How Participants First Heard about the Program

Information Source	Total (n=87)	Direct Install (n=66)	Self Install (n=21)
Direct walk-in	52%	65%	10%*
Bill insert	21%	15%	38%
Cold call	6%	6%	5%
Ameren mailing	6%	-	24%
Friend/colleague/word of mouth	5%	3%	10%
Ameren e-mail	5%	5%	5%
Ameren website	3%	2%	10%
Chamber of Commerce	1%	2%	-

*Note: Survey respondents classified themselves as either direct or self install, and in some cases their classification differed from program tracking data. As a result, a small number of self install participants mention receiving a walk-in, although this was mainly a direct install strategy.

While not a major source of program awareness during this program year, interviews with program staff highlighted the important role of local Chambers of Commerce in raising program awareness. Not only did they provide Ameren Illinois with a list of local businesses with commercial kitchens, but they also left program staff feeling optimistic and positive about the Chambers' role in general program outreach and marketing.

Recall and Usefulness of Messages

Thirty-six percent of participants recall seeing or receiving marketing materials related to the Green Nozzle Program. Of those who report seeing them, the majority remember seeing information about the Green Nozzle Program in an Ameren Illinois brochure (66%).

Overall, all participants who recall seeing or receiving materials find them useful. Forty-eight percent find them "very useful", and 52% find them "somewhat useful". To gauge participant perceptions of the level of marketing related to the program, they were asked how frequently they felt they heard about the green nozzles program. Almost half of the respondents (48%) report they have heard, seen or read about the program somewhat or very frequently over the past year.

In terms of future marketing efforts, participants would most like to receive program information via flyers or mailings (52%), bill inserts (32%), telephone (26%), or e-mail (24%).

Program Processes

Participation Process and Requirements

The program processes were effective in providing free green nozzles to eligible facilities, either through direct install or direct mail. All of the program participants found the process to be clear, and none called Ameren Illinois with questions and or complaints. This suggests

well developed materials about the program.

Identification of Green Nozzle Program

Most participating customers decided to participate in the program after being directly approached by a program representative. Fifty-two percent of participating facilities became involved with the program after an Ameren Illinois representative walked into the facility and explained the program. Another 17% responded to a direct call from Ameren Illinois. As expected given the emphasis on direct installation in PY2, only 28% of facilities were more proactive about the program and, after seeing marketing information, sought out the green nozzle by calling Ameren Illinois themselves.

Installation Process

The installation process ran very smoothly. For those facilities where the nozzle was directly installed, most (67%) had their nozzle installed on the same day the representative walked into their facility. Further, for 77% of these facilities the process took less than 15 minutes. The direct install process also allowed for an exchange of information about energy efficiency. For example, 72% of the direct install customers recall the installer talking about general energy efficiency options with them.

Although the speed at which customers received their nozzle or nozzles was slower for the direct mail delivery channel, customers still felt the process went smoothly. Sixty-seven percent received the nozzle within one week of their initial request, and 96% said that it was extremely easy to install the green nozzle.[43]

Customer Satisfaction

Program Administration

While participants expressed satisfaction with the program processes, many were dissatisfied with the green nozzle they received through the program. In particular, 17% of participating customers were dissatisfied with the green nozzle – a rating of zero through three on a scale of 0 to 10 - including 10% who were extremely dissatisfied – a rating of 0. Eighty-one percent of those who were dissatisfied with the green nozzle expressed that the low water pressure was not powerful enough to effectively rinse the dishes.

Table 11: Participant Mean Satisfaction Ratings for Various Program Elements

How would you rate your satisfaction with...?	Mean Rating
The representative who installed the green nozzle*	9.1 *(n=65)*
The customer service representative	9.2 *(n=67)*
Green Nozzle Program overall	8.2 *(n=94)*
Ameren Illinois Utilities	7.9 *(n=92)*
The green nozzle	7.0

[43] Refers to a rating of 10 on a 0 to 10 scale, where 0 means "extremely difficult" and 10 signifies "extremely easy"

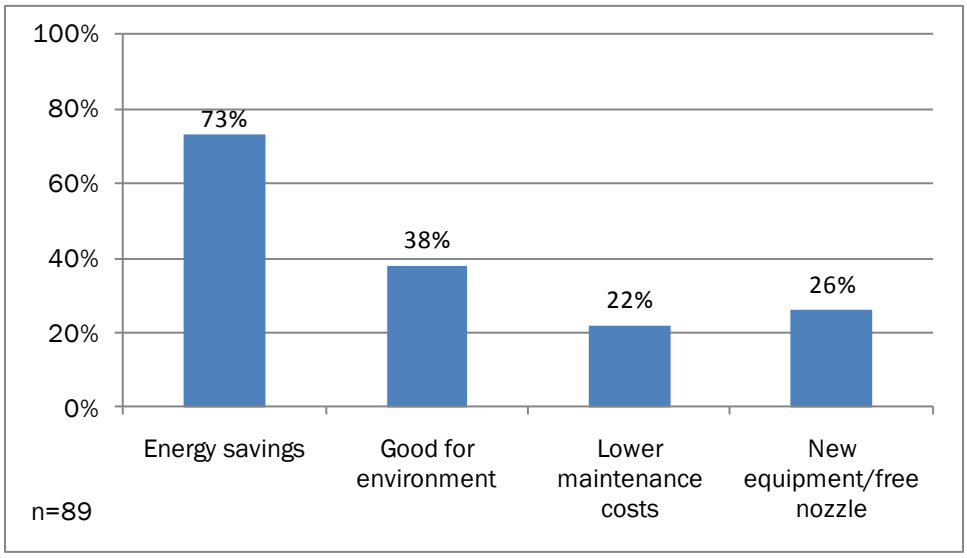
	(n=93)

* Asked only of those who participated through the direct install
Note: Scale is from 0 to 10 where 0 is "very dissatisfied" and 10 is "very satisfied."

Program Benefits

Overwhelmingly, the main benefit cited by participants is the energy savings achieved, followed by the fact that it is good for the environment. As a result, messaging that stresses the monetary and energy savings achieved through the low-flow nozzle has the potential to resonate with potential participants.

Figure 3: Main Benefits to Participating in the Program
(Multiple Response)



Measure Persistence

Close to a quarter of participating customers no longer have any of their green nozzles in place (22%).[44] The majority of those who are no longer using the green nozzles explain that the low water pressure from the nozzle could not effectively clean their dishes (60%). Others mentioned that their nozzle stopped working or broke (25%). In general, almost all of the nozzles removed were removed within one month (42%) or between one and six months (47%) from the date of installation. Among those who no longer have their nozzle installed, 76% replaced the green nozzle with their original nozzle, and another 14% put on a new nozzle that was intentionally not low-flow. Only one survey respondent stated that they installed a new nozzle that was also low-flow while two others said they either didn't know what they had installed or they no longer use a nozzle at all.

Potential Barriers to Participation

Close to three quarters of participants (72%) do not see any drawbacks to participating in the Green Nozzle Program. Overall, 15% of all participants said that the equipment does not work well while 3% said they worried it was a gimmick given that the nozzle was free, and 2% said the wait time for the nozzle was too long.

[44] One additional participant removed one of two nozzles installed at their facility.

When customers were asked why others are not participating, they cited a lack of program awareness (77%) and lack of knowledge of potential energy savings (18%) as the greatest reasons why similar companies probably do not participate. However, our research did not include depth interviews with non-participants. As a result, we cannot directly measure barriers to participation in the program.

Impact Results

Measure Algorithm Engineering Analysis

We first analyzed the algorithm used to calculate gas savings associated with low flow nozzles.

Green Nozzle Algorithm and Inputs

The engineering equation

$$Q = \dot{m} c_p \Delta T$$

is detailed to calculate the gross energy saved in therms per year per nozzle as follows:

$$Q = \frac{(flow_1 - flow_2)\frac{galH_2O}{min} \cdot 60\frac{min}{hr} \cdot 8.33\frac{lbm}{galH_2O} \cdot 1\frac{BTU}{lbm°\mathrm{F}} \cdot \Delta T}{\mu \cdot 100{,}000\frac{BTU}{Therm}} \cdot \frac{hours}{day} \cdot \frac{days}{year}$$

Where:

Q = Energy (therms)

$flow_1$ = average water flow rate of a typical rinsing nozzle

$flow_2$ = water flow rate of energy efficient Bricor nozzle

ΔT = water heater water temperature rise

μ = efficiency of gas water heater

Table 12 shows the inputs with the ex ante values and our ex post values. The sources for the ex post values are included in the footnotes and further discussed below.

Table 12: Green Nozzle Inputs

Inputs	Original Deemed Savings Calculation (Ex ante)	Ex Post Savings Calculation
Flow rate 1 (gal/min)[45]	1.6	2.3

[45] There is no federal standard for pre-rinse spray valves. Researchers at FSTC estimate the industry average at 3.0 gpm. http://www1.eere.energy.gov/femp/pdfs/prerinsenozzle.pdf

Inputs	Original Deemed Savings Calculation (Ex ante)	Ex Post Savings Calculation
Flow rate 2 (gal/min)[46]	0.7	0.65
Hours per day[47]	3	4.3
Days (days/year)[48]	365	362
Heater efficiency[49]	70%	67.6%
Temp rise in water heater	70°	73°
Output – Gross Savings	492.6 Therms	1386.2 Therms
NTGR	0.8	0.82
Output - Net Savings	**394 Therms**	**1122.8 Therms**

Note: the ex post NTGR input is based on participant survey data.

Our ex post value is higher than the ex ante per unit value due mainly to the changed baseline flow rate.

Engineering Assessment of Algorithm and Inputs

Algorithm:

The algorithm used and described above is appropriate.

Inputs:

Flow Rate

The original deemed savings calculation used a baseline flow rate of 1.6gpm and a low flow rate of 0.7 gpm. The value of 1.6 gpm is the Food Service Technology Center (FSTC) recommended target for energy efficient nozzles. The value of 0.7 gpm likely came from the FSTC study results for a Bricor nozzle (B064 PRV), which had the lowest flow (0.65 gpm) with acceptable cleaning performance. The value of 0.7 gpm was used instead of 0.65 gpm because FSTC's calculator does not accept 2 place decimals.

The ex post algorithm uses a baseline flow rate of 2.3 gpm. According to a study by FSTC, the average standard nozzle uses 3 gpm. This value was reported in 1994. We used a more conservative value of 2.3 gpm (the average of 3 gpm and 1.6 gpm) which assumes some market saturation of more efficient nozzles since the Center conducted the study.

Hours of Use

[46] Testing done by FTSC http://www.fishnick.com/equipment/sprayvalves/Bricor_B064_PRV.pdf

[47] From market research, Fisher Nickel's expertise, and conversations with CEE's Commercial Kitchens committee members and program manager

[48] Based on survey responses indicating an average of 362 days a year of operation

[49] Baseline used 67.6% "Energy Efficiency Potential of Gas-Fired Commercial Hot Water Heating Systems in Restaurants" http://www.fishnick.com/publications/appliancereports/special/Commercial_Water_Heating_Systems.pdf

Total yearly energy savings requires estimation of the total number of hours a nozzle is used in one year. An average of 3 hours per day had been estimated based on market research, Fisher-Nickel's expertise, and conversations with CEE's Commercial Kitchens committee members and program manager. The original savings estimate also assumed 365 day/year operation. The ex post evaluation uses a more conservative estimate of 6 days per week and 312 days per year.

Responses from the participant survey indicate a total average hours of use per day of 4.3 hours. In addition, these survey data indicates that facilities operate for an average of 362 days per year. As a result, the final ex post savings calculation is adjusted slightly.

Water Heater Efficiency

The ex post baseline input for water heater efficiency is 70%, which comes from the FSTC study "Energy Efficiency Potential of Gas-Fired Commercial Hot Water Heating Systems in Restaurants" (the actual baseline efficiency used is 67.6%[50]). Hot water heater storage losses, which might decrease system efficiency, may be ignored because it is assumed that the hot water heater usage is high during the time a nozzle is used. The efficiency level used to calculate energy savings is conservatively high (as efficiency increases, deemed savings decrease). Energy Star lists numerous hot water heater system efficiencies in the range of 57% to 63% efficient.

Temperature Rise

A temperature rise of 70°F is often used by FSTC and other sources to represent a temperature differential of incoming groundwater (55°F) to hot water temperature set-point (120 - 130°F). While the hot water set-point necessary for washing dishes must be higher than this, the nozzle is used by people and preventing the scalding of hands is essential. Therefore, a temperature rise of 70°F is appropriate.

However, based on data from the participant survey, the average water temperature increase is 73°F. This number is calculated based on those customers who provided a response (22%), assuming all those who did not respond have the standard value of 70°F.

Program Level Impacts

Our impact analysis activities yielded ex post gross therm impact estimates that exceeded the ex ant estimates. The ex post gross impacts are higher than the ex ante values as a result of recommended changes to the green nozzle algorithm, specifically flow rate and days of use assumptions.

[50] FSTC. "Energy Efficiency Potential of Gas Fired Commercial Hot Water Heating Systems in Restaurants." April 2007. Available: http://www.fishnick.com/publications/appliancereports/special/Commercial_Water_Heating_Systems.pdf

Table 13 below presents the estimates gross impacts, as well as the estimated NTGR and program level net energy impacts attributable to the program. We also recommend the inclusion of an in-service factor to account for the 18% removal rate among participating customers.

Table 13: Gross and Net Impacts

	N	In-Service Rate	Per Unit Savings	Gross Therms	Net to Gross Ratio	Net Therms
Ex Ante	1,301	100%	493	640,873	0.80	512,698
Ex Post	1,301	82%	1,386	1,481,428	0.82	1,213,424
			Realization Rate	2.31		2.37

Note: Realization Rate= Ex Post Value/Ex Ante Value

Variation in NTGRs by project affected the overall net impact of the program. While close to three quarters of the projects had a NTGR of 1.0, a number of other projects had NTGRs below 0.3, which lowered the average.

Conclusions and Recommendations

Conclusions

Overall, both program staff and participating customers are generally satisfied with the program processes and satisfaction with the program did not differ based on the structure of program delivery. Therefore, while limiting one-on-one contact with customers, continuing with the direct mail campaign remains the most cost effective strategy for the Green Nozzle Program in PY3. If this approach is adopted, the program staff should monitor participation levels to determine whether direct installation of the nozzles is essential to driving participation in the program. Additionally, the program staff's plans to add a green nozzle option to the standard food service application is a welcome change for PY3 that will likely help to improve the data tracking process as well.

Despite the overall success of the program, measure persistence is a major hurdle in PY2. Almost a quarter of participating customers no longer have their green nozzle installed, and about 10% were extremely dissatisfied with the green nozzle installed through the program. If feasible, switching models or changing the flow-rates of the nozzle, while potentially sacrificing some efficiency, may ultimately lead to greater therm savings as a result of more consistent and sustained use over time.

Both ex post gross and net impacts exceeded ex ante impacts. While the NTGR's were similar for both ex ante and ex post, the recommended changes to the gross impact algorithm inputs caused an increase in the deemed value which translated into higher gross savings estimates.

Impact Recommendations

Based on our assessment of impacts, we make the following recommendations:

- Update per Unit Savings: There is sufficient support for the input changes for us to

recommend that the gross per-unit savings be increased to 1386 therms.

- Assume a Removal Rate: The program implementers should assume a removal rate of at least 18% and account for this through the use of an in-service rate of 82%.

Process Recommendations

Key recommendations related to the program processes are:

- Data Tracking: Improve the compatibility of current Excel file tracking systems with the AIB database system or create a mechanism by which Green Nozzle Program data are entered directly into AIB as is the case for other C&I programs. As part of this effort, program staff should ensure that all data fields are properly populated. Business type is one example of a data field the evaluation team found only partially populated.
- Program Processes: Despite the fact that participants found both the application process easy to understand and complete, Ameren Illinois has already made a change to the commercial food service program application to include a check box for green nozzle requests. This should help improve the data tracking.

Program Offerings: Program staff should consider possible approaches to remedy dissatisfaction with the green nozzles provided through the program. If alternative models are available, the program should determine whether Ameren Illinois can change the equipment offered through the program.